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Introduction

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Scientific and technical reports of the National Aeronautics and Space Administration and its contractors; scientific and technical reports of government agencies, universities, and research organizations throughout the world.

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By arrangement between NASA and the American Institute of Aeronautics and Astronautics, the AIAA publication *International Aerospace Abstracts* is issued in coordination with *STAR*. Each journal appears on alternate weeks. *IAA* uses subject categories identical with those in *STAR*, and publishes similar indexes. *IAA's* worldwide coverage of books and scientific and trade journals complements *STAR's* worldwide report coverage. The two publications thus provide comprehensive access to current literature on aerospace science and technology.

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The Preliminary Edition of the *NASA Thesaurus* (December 1967) (NASA SP-7030) is being used as the authority for the indexing vocabulary that appears in the subject index to this issue. The terminology has been modified from the *Guide to the Subject Indexes for STAR* (NASA SP-7016), the authority used for the vocabulary to indexes published prior to 1968. The *NASA Thesaurus* should be consulted for a total picture of the current indexing vocabulary including associated cross reference structure. Only the subject terms that have been selected to describe the documents abstracted in this issue appear in the subject index. Copies of the *NASA Thesaurus* may be obtained from the Clearinghouse for Federal Scientific and Technical Information or the U. S. Government Printing Office at a price of $8.50 for the three-volume set.

Volume 6 Number 7 / April 8, 1968

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V. 6
1968
Apr.-June

TABLE OF CONTENTS

Subject Categories

Abstracts in the journal are grouped under the following categories: *page:*

01 AERODYNAMICS
Includes aerodynamics of bodies, combinations, internal flow in ducts and turbomachinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion. **933**

02 AIRCRAFT
Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics. **934**

03 AUXILIARY SYSTEMS
Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems. **937**

04 BIOSCIENCES
Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology. **941**

05 BIOTECHNOLOGY
Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences. **948**

06 CHEMISTRY
Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants. **952**

07 COMMUNICATIONS
Includes communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation. **961**

08 COMPUTERS
Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics. **968**

09 ELECTRONIC EQUIPMENT
Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation. **972**

10 ELECTRONICS
Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories. **976**

11 FACILITIES, RESEARCH AND SUPPORT
Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations. **981**

12 FLUID MECHANICS
Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion. **983**

13 GEOPHYSICS
Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences. **989**

14 INSTRUMENTATION AND PHOTOGRAPHY
Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras. **994**

15 MACHINE ELEMENTS AND PROCESSES
Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control; reliability; drafting; and materials fabrication, handling, and inspection. **1002**

16 MASERS
Includes applications of masers and lasers. For basic research see: 26 Physics, Solid-State. **1004**

17 MATERIALS, METALLIC
Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see : 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics. **1006**

18 MATERIALS, NONMETALLIC
Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics. **1010**

19 MATHEMATICS
Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers. **1013**

20 METEOROLOGY
Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences. **1016**

21 NAVIGATION
Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications. **1021**

22 NUCLEAR ENGINEERING
Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems. **1023**

23 PHYSICS, GENERAL
Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics, 20 Meteorology, and 29 Space Radiation. **1034**

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR
Includes atomic, molecular and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation. **1038**

25 PHYSICS, PLASMA
Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems. **1055**

26 PHYSICS, SOLID-STATE
Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics. **1064**

27 PROPELLANTS
Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems. **1071**

28 PROPULSION SYSTEMS
Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants. **1072**

29 SPACE RADIATION
Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear. **1075**

30 SPACE SCIENCES
Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbits and trajectories. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles. **1077**

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics. **1084**

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic. **1088**

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants. **1093**

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents. **1100**

SUBJECT INDEX I-1

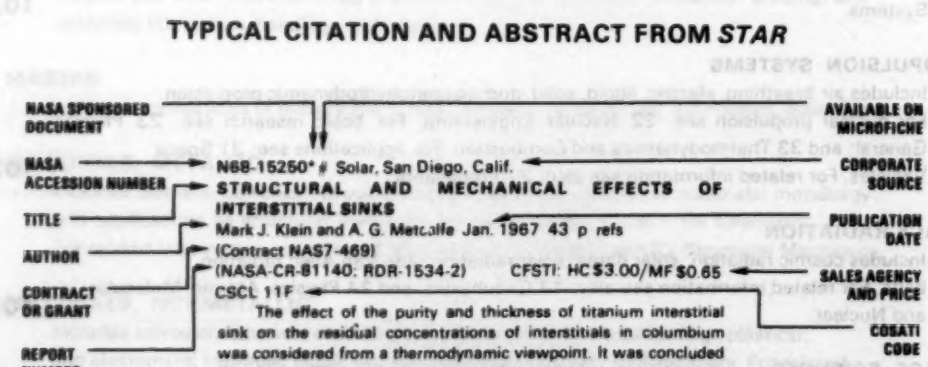
PERSONAL AUTHOR INDEX I-65

CORPORATE SOURCE INDEX I-91

REPORT/ACCESSION NUMBER INDEX I-107

ACCESSION/REPORT NUMBER INDEX I-117

TYPICAL CITATION AND ABSTRACT FROM *STAR*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N68-15250* # Solar, San Diego, Calif.
STRUCTURAL AND MECHANICAL EFFECTS OF INTERSTITIAL SINKS
Mark J. Klein and A. G. Metcalfe Jan. 1967 43 p refs
(Contract NAS7-469)
(NASA-CR-81140; RDR-1534-2) CFSTI: HC $3.00/MF $0.65
CSCL 11F
The effect of the purity and thickness of titanium interstitial sink on the residual concentrations of interstitials in columbium was considered from a thermodynamic viewpoint. It was concluded that the equilibrium concentrations of interstitials in columbium is not a sensitive function of these parameters. The structure and hardness of Ti/D-43 diffusion couples were correlated with the partitions of interstitials between the two metals. A reduction in the oxygen and carbon concentration in the D-43 correlates with an increase in the grain size and a change in the grain morphology of this alloy. The equilibrium partition of interstitials between the titanium and the D-43 is believed to account for an increase in the hardness of the titanium, but this partition does not seem to affect the hardness of the D-43. Author

VOLUME 6, NUMBER 7 / APRIL 8, 1968

Scientific and Technical Aerospace Reports

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01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N68-16266# Aerodynamische Versuchsanstalt, Gottingen (West Germany). Abteilung Raumfahrt—Aerodynamik.

THE HYPERSONIC, PLANE FLOW-FIELD AROUND A PLATE NORMAL TO THE STREAM AT VERY LOW GAS DENSITY (KNUDSEN NUMBER Kn → ∞) [DAS HYPERSONISCHE, EBENE STROEMUNGSFELD UM EINE QUERGESTELLTE PLATTE BEI SEHR GERINGER GASDICHTE (KNUDSEN-ZAHL Kn→∞)]

K. Kraemer Sep. 1967 34 p refs In GERMAN; ENGLISH summary Presented at DGRR/WLGR Ann. Meeting, Karlsruhe, West Ger., 3–6 Oct. 1967

(AVA-FB-6707; DLR-FB-67-64; DK-533.722; DK-533.6.011.8)

The steady, plane flow of a rarefied, monatomic gas with an infinite free path around a flat plate normal to the stream is considered, assuming "diffuse" reflexion of the impinging atoms. The distribution of the reflected atoms is the same as that of the flow from a slot, imagined to take the place of the plate. A closed, exact solution is presented for the field of this plane "Knudsen-effusion". It is used to derive an approximate description of the field around the plate at large Mach-numbers. Author

N68-16299*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

WIND TUNNEL INVESTIGATION OF THREE PROPOSED LAUNCH VEHICLES AT MACH NUMBERS FROM 2.30 TO 4.63

A. B. Blair, Jr. and Melvin M. Carmel Washington Feb. 1968 66 p

(NASA-TM-X-1498) CFSTI: HC $3.00/MF $0.65 CSCL 01A

A wind tunnel investigation has been made to determine the aerodynamic characteristics of three 1/12.4-scale models of proposed multi-stage launch vehicles. Tests of the second stage alone were made of the models. The investigation included tests of models both with and without fins and auxiliary boosters. The results of the investigation indicated approximately linear variations of the aerodynamic coefficients with angle of attack and sideslip over the range of the tests. The first-stage fins were effective in providing stabilizing increments of pitching and yawing moment although the increments decreased with increasing Mach number. The rolling moment due to sideslip appeared to be reasonably small over the range of the tests. Author

N68-16378# Aerospace Research Labs., Wright-Patterson AFB, Ohio. Hypersonic Research Lab.

INVESTIGATION OF OPTIMUM LIFTING BODIES

Wilbur L. Hankey *In* Office of Aerospace Res. Proc. of the OAR Res. Appl. Conf., 14 Mar. 1967 Mar. 1967 p 21–37 refs (See N68-16376 07-34)

Hypersonic lifting configurations were optimized to produce maximum lift-to-drag ratios for constraints of volumetric efficiency, heating, and skin friction. Geometric details of these configurations are presented which show them to be wedge-nosed shapes with conical afterbodies and hemispherical bases. Although the hypersonic lift-to-drag ratio is appreciably reduced by a heating limitation, it is the skin friction which severely limits maximum value of lift-to-drag ratio to less than four for flight application. Correlation of these results with wind tunnel data is shown to verify the aerodynamic characteristics. The resulting optimized configurations are shown to be substantially superior to any previous developmental flight vehicles. Author

N68-16385# Aerospace Research Labs., Wright-Patterson AFB, Ohio. Hypersonic Research Lab.

PREDICTION OF THE DYNAMIC STABILITY OF NOSE CONES

Brian P. Quinn *In* Office of Aerospace Res. Proc. of the OAR Res. Appl. Conf., 14 Mar. 1967 Mar. 1967 p 189–208 refs (See N68-16376 07-34)

The flow around a blunted slender cone performing pitching oscillations is theoretically analyzed by means of Chernyi's blast-wave piston analogy. Stationary and transient shock shapes and pressure distributions are presented in power series form. Within the region of convergence, the stationary pressure agrees well with Chernyi's numerical integration. Normal force and pitching moment coefficient derivatives are presented and the results are plotted for a 10° cone. The theoretical static and dynamic stability derivatives agree satisfactorily with recent experiments in a Mach 14 wind tunnel. It is concluded that the experimentally observed reduction in static and dynamic stability due to increased nose bluntness may be attributed to blast wave effects. Author

N68-16480*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

SUPERSONIC AERODYNAMIC CHARACTERISTICS OF A MODEL OF AN AIR-TO-GROUND MISSILE

Clyde Hayes Washington Feb. 1968 40 p

(NASA-TM-X-1491) CFSTI: HC $3.00/MF $0.65 CSCL 01A

An investigation was conducted to determine the aerodynamic characteristics of a model of an air-to-ground missile simulating both the boost- and glide-phase configurations. The results include the effects of fin size and sweep angle as well as the effects of the size and deflection of the control wings. The investigation was conducted for model roll angels of 0° and 45° at Mach numbers

of 1.60 and 2.00 at a Reynolds number of 8.41×10^6 based on the body length. The results of the investigation indicated that the body–fin combination was generally stable about the assumed moment center for the range of fin size and fin sweep angle of the tests, although at Mach number 2.00 and at a sweep angle of 65° regions of instability were indicated for angles of attack above about 9°. The addition of the control wings had little effect on the longitudinal stability but did produce a substantial increase in normal-force curve slope and in axial force. Deflection of the control wings was effective in providing increments of side force and normal force with essentially no effect on pitching or yawing moments. The presence of wing slots, which simulated slots into which the wings fold, had no effect on the aerodynamic characteristics of the model. Author

N68-16547# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.

LIFTING SURFACE IN TRANSONIC GAS FLOW [NESUSHCHAYA POVERKHNOST' V OKOLOZVUKOVOM POTOKE GAZA]

A. N. Panchenkov Feb. 1968 23 p refs Transl. into ENGLISH from Russian

(TR-47)

A nonlinear approximation for three dimensional lifting surfaces in transonic flow is developed. The method is applied to a symmetric body and a thin wing for both the two and three dimensional case. Author

N68-16605# Nationaal Lucht-en Ruimtevaartlaboratorium, Amsterdam (Netherlands).

A SURVEY OF SYMMETRICAL TRANSONIC POTENTIAL FLOWS AROUND QUASI-ELLIPTICAL AEROFOIL SECTIONS

J. W. Boerstoel Jan. 1967 16 p refs Sponsored by Neth. Aircraft Develop. Board *Its* Rept. and Trans. Vol. 35

(NLR-TR-T-136) CFSTI: HC $3.00/MF $0.65

The hodograph method and its application allow the construction of steady transonic potential flows around aerofoil sections. This report gives results of the application of this method as far as non-lifting symmetrical sections are concerned. The results show that with a restricted use of the possibilities of the method an already remarkable variety of practically interesting sections and corresponding pressure distributions can be obtained. The sections can be computed with a precision sufficient to meet accuracy requirements of model manufacturing. Author (ESRO)

N68-16609# Nationaal Lucht-en Ruimtevaartlaboratorium, Amsterdam (Netherlands).

TRANSONIC POTENTIAL FLOW AROUND A FAMILY OF QUASI-ELLIPTICAL AEROFOIL SECTIONS

G. Y. Nieuwland (Ph.D. Thesis—Groningen Univ.) Jul. 1967 70 p refs Sponsored by Neth. Aircraft Develop. Board

(NLR-TR-T-172) CFSTI: HC $3.00/MF $0.65

A new development of the analytical hodograph theory of Chaplygin, Cherry and Lighthill is based on integral transform methods. Transonic potential flows around a family of both non-lifting and lifting quasi-elliptical two-dimensional aerofoils are obtained, and various practical examples shown. The closure of a-symmetrical aerofoils in the physical plane is ensured by a special construction. A discussion of the physical aspects of these flows and of local aspects of the hodograph transformation, and numerical problems, is concluding the report. Author (ESRO)

N68-16662# Boeing Co., Renton, Wash. Commercial Airplane Div.

THE FLEXIBLE WING: GENERAL PROPERTIES AND APPLICATIONS [L'AILE SOUPLE: PROPRIETES GENERALES ET APPLICATIONS]

Rene Landais 10 Nov. 1967 39 p refs In FRENCH Presented at the App. Aerodynamic Colloq. at A.F.I.T.A.E., 8–10 Nov. 1967

Aerodynamic properties of the flexible wing concept are discussed, and longitudinal and transverse aerodynamic characteristics are detailed along with the advantages and disadvantages of the flexible wing concept. Wind tunnel testing and actual flight results are included in this dialogue which was written to accompany a film. Transl. by M.W.R.

N68-16781# Deutsche Forschungsanstalt fur Luft- und Raumfahrt, Brunswick (West Germany). Institut fuer Strahlantriebe.

INVESTIGATIONS ON THE FLOW FIELD AROUND PYRAMID-SHAPED CENTERBODIES OF JET ENGINE INLETS [UNTERSUCHUNGEN UEBER DAS STROENUNGSFELD UM PYRADIDEN FOERMIGE ZENTRALKOERPER VON TRIEBWERKSEINLAEUFEN]

Norbert Schmidt (M.S. Thesis–Tech. Hochschule Carolowilhelmina) 5 Sep. 1967 135 p refs In GERMAN; ENGLISH summary

(DLR-FB-67-72; DK-621.454:533.6.011.5; DK-533.697.2; DK-533.696.4.047)

A square pyramid may be used as a centerbody of a supersonic intake of variable geometry, which joins the advantage of a three-dimensional compressing cone and that of plane surfaces of a wedge. The flow field around the centerbody is the point of interest. Results of an extended slender body theory-extended by elements of the nonlinear cone flow theory–are given, especially the distribution of pressure and Mach number in the flow field around the body, the pressure drag of the body, and the shape of the shock. These results are compared with experimental data from a pyramid with a 25° apex half angle at Mach numbers ranging from 2 to 3. Author

N68-17049# Association Francaise des Ingenieurs et Techniciens de L'Aeronautique et de l'Espace, Paris.

CALCULATION OF THREE DIMENSIONAL WINGS [CALCUL D'AILES TRIDIMENSIONNELLES]

10 Nov. 1967 31 p refs In FRENCH Presented at App. Aerodyn. 4th Colloq. at A.F.I.T.A.E., 8–10 Nov. 1967

Methods of calculating properties of three-dimensional wings are detailed, including corrections according to linear theory and the extension of Riegels' method. Transonic phenomena and subcritical and supercritical profiles are discussed, as is the effect of bending. Distortion of a wing into different sections, rectilinear generation of a section, and a reference system of speeds related to the wing surface are illustrated. The presented methods permit the determination of optimum flying surfaces of various aerodynamic characteristics. Transl. by M.W.R.

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N68-16256# Aerodynamische Versuchsanstalt, Gottingen (West Germany). Abteilung Aeroelastizitaet.

PROBLEMS IN GROUND VIBRATION TESTING OF AIRCRAFT [ZUR PROBLEMATIK DES STANDSCHWINGUNGSVERSUCHS AN FLUGKOERPERN]

H. Foersching Sep. 1967 42 p refs In GERMAN; ENGLISH summary

(AVA-FB-6706; DLR-FB-67-63; DK-533.6.013.42)

The report contains the present stage, the importance and some special problems in ground vibration testing of aircraft. Refering to the wellknown linearized equations for the numerical treatment of aeroelastic problems, the test methods and test procedures were explained and some recent developments were shortly discussed. Some special elastomechanical properties of aircraft, such as nonproportional distribution of structural damping, structural asymmetries and non-linearities of the structure have been investigated, and the resulting difficulties in measuring the dynamic parameters of the aircraft were shown. Finally, it is referred to the importance and the special problems of the ground vibration test on space vehicles. Author

N68-16349*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

SOME RECENT RESEARCH RELATED TO APPROACH PROBLEMS

George E. Cooper [1967] 12 p Presented at the Flight Safety Seminar, Williamsburg, Va., 4–6 Dec. 1967

(NASA-TM-X-60859) CFSTI: HC$3.00/MF$0.65 CSCL 01B

Methods of improving vertical flight path control of large, sluggish airplanes are discussed in relation to the simulator and flight assessments made of direct-lift control (DLC). As studies with a piloted flight simulator using both ILS instrument and visual approaches proved encouraging, flight tests were undertaken on a Convair 990. The results indicate that the DLC can provide improved short period pitch and flight path response for sluggish airplanes. Multiple forms of integration in the airplane appear to provide additional benefits, but more detailed study is considered necessary. Methods of reducing airplane noise during landing approach, by using steeper approach angles, are also discussed. The use of DLC in steep and segmented landing approaches was evaluated both on ground-based and in-flight simulation, using the variable-stability Boeing 367-80. It was concluded that the problems limiting the use of steep approaches for noise abatement are high sink rate near the ground, high pilot work load in the approach, inadequate guidance and display information, and flight path control problems. M.G.J.

N68-16476*# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.

CONJUGATE GRADIENT METHODS WITH AN APPLICATION TO V/STOL FLIGHT-PATH OPTIMIZATION

R. K. Mehra and A. E. Bryson, Jr. Nov. 1967 36 p refs

(Grant NGR 22-007-068; Contract N00014-67-A-0298-0006)

(NASA-CR-91880; TR-543; AD-662686) CFSTI: $3.00/MF $0.65 CSCL 01B

Conjugate gradient methods have recently been applied to some simple optimization problems and have been shown to converge faster than the methods of steepest descent. The present paper considers application of these methods to more complicated problems involving terminal as well as in-flight constraints. A number of methods are suggested to handle these constraints and the numerical difficulties associated with each method are discussed. The problem of flight-path optimization of a V/STOL aircraft was considered and minimum time paths for the climb phase were obtained using the conjugate gradient algorithm. In conclusion, some remarks are made about the relative efficiency of the different optimization schemes presently available for the solution of optimal control problems. Author (TAB)

N68-16516# Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Flight Dynamics Lab.

EXTERNAL VISIBILITY CRITERIA FOR VTOL AIRCRAFT Final Technical Report, 1 Jul. 1965–1 Jul. 1966

Edward O. Roberts Mar. 1967 65 p refs

(AFFDL-TR-67-27; AD-655072)

The report contains a discussion of some influencing factors which affect the physical ability of the pilot to see externally from the aircraft along with the restrictions they present to the field of view. Visibility data are presented on four experimental VTOL aircraft, XV-4A, XV-5A, X-22, and XC-142A, in the form of binocular photographs, a criteria tool is provided by establishing the depression angle of the spherical coordinate system as a parameter to determine the visibility requirements for the terminal landing phase of a VTOL aircraft. Finally, an abbreviated set of tables is presented to transfer the 'degrees-to-the-side and degrees-down' coordinate system. Author (TAB)

N68-16521*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

NOISE MEASUREMENTS DURING TAKE-OFF-CLIMBOUT OPERATIONS OF JET TRANSPORTS

W. Latham Copeland [Nov. 1967] 16 p refs Presented at the 74th Meeting of the Acoust. Soc. of Am., Miami Beach, Fla., 14–17 Nov. 1967

(NASA-TM-X-60863) CFSTI: HC$3.00/MF$0.65 CSCL 01C

Data were obtained under closely controlled conditions for both simulated and actual climbouts with the objective of correlating the operation of the aircraft with the measured noise. Two-, three-, and four-engine commercial jet aircraft having turbojet and turbofan engines were included in the program. Good correlation was found between the ground noise measurements and such factors as flight profile, engine thrust, flap setting and aircraft speed. Parametric charts are included to illustrate the significance of the above variables and are shown to be useful for ground noise predictions. Author

N68-16522*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

AN ANALYSIS OF VGH DATA FROM ONE TYPE OF FOUR-ENGINE TURBOJET TRANSPORT AIRPLANE DURING COMMERCIAL OPERATIONS

Paul A. Hunter Washington Feb. 1968 48 p refs

(NASA-TN-D-4330) CFSTI: HC$3.00/MF$0.65 CSCL 01C

An analysis of VGH records collected on one type of four-engine turbojet transport during routine commercial operations on two airlines has provided information on acceleration, turbulence, and airspeed operating practices. The data cover operations of two airplanes by one airline on eastern United States and Caribbean routes and of one airplane operated by a second airline on routes which ranged along the east coast of the United States, across the Caribbean Sea and along the west coast of South America. For the two airplanes operated by the same airline, the results were very similar in regard to the gust-velocity experiences and the accelerations caused by gusts, operational maneuvers, check-flight maneuvers, and landing impact. The results indicated that the acceleration experiences, the gust velocity experiences, and the airspeed operating practices were not significantly different for the airplanes operated by the two airlines. In general, the airspeeds in rough air (gust velocity $\geq$ 2 fps (0.6 m/sec)) were approximately equal to the airspeeds in smooth air. The results indicated, however, that the airspeeds in heavy turbulence (gust velocities higher than 20 fps (6.1 m/sec)) were generally lower than the average operating speeds. Author

N68-16651# British Aircraft Corp., London (England).

POSSIBILITIES AND PROBLEMS OF NEW TYPES OF AIRCRAFT DURING THE DECADE 1970–1980

R. M. Clarkson (Hawker Siddeley Aviation), G. Gabrielli (Fiat S.P.A.), and A. H. C. Greenwood

In identifying European civil aerospace projects as having potential for the coming decade, it is felt that the logical evolutionary developments of subsonic airlines, together with the advent of practical V/STOL transports, will provide the mainstay of world air travel during the 1970s, with the impact of the supersonic transports felt mainly on longer routes. The design concepts of the European Airbus are outlined, along with the special considerations

given to the problems of passenger, bagge, a freight handling in such a large aircraft. The need for commercially acceptable intercity and V/STOL transports is pointed out, as is the place in the world market for a small, low cost aerial truck to extend the benefits of air transport in developing countries. The Anglo–French Concorde is discussed as an example of supersonic civil transport. Consideration is also given to military tactical and trainer aircraft, tactical helicopters, and military variable geometry. The possibility of hypersonic aircraft by the end of the 1970s is mentioned. M.G.J.

N68-16796 Association Francaise des Ingenieurs et Techniciens de l'Aeronautique et de l'Espace, Paris

LANDING AND FORCED LANDING TESTS ON THE MODEL [ESSAIS D'ATTERRISSAGE ET D'ATTERRISSAGE FORCE SUR MAQUETTE]

J. Gobeltz 10 Nov. 1967 50 p In FRENCH Presented at the App. Aerodynamic 4th Colloq. at A.F.I.T.A.E., 8–10 Nov. 1967

Details are given on the construction of models for both normal and forced landing tests, and on the design differences which the test conditions impose. Wind tunnel installations are described, along with the methods for measuring and recording the data, and the positioning of television cameras for immediate observations. Particular emphasis is placed on the program undertaken to validate the various test methods, and to assess the results of the tests made on the models in relation to everyday examples of aircraft landings. Transl. by M.G.J.

N68-16834# National Severe Storm Lab., Norman, Okla.

NOTE ON PROBING BALLOON MOTION BY DOPPLER RADAR

Roger M. Lhermitte Jul. 1967 21 p refs Presented at Am. Meteorol. Soc. on Phys. Processes in the Lower Atmosphere, Ann Arbor, Mich., 20–22 Mar. 1967 Sponsored in part by FAA

(IERTM-NSSL-34; PB-175930) CFSTI: HC $3.00/MF $0.65

The motion of free balloons was analyzed with Doppler radar techniques. Balloons in the subcritical Reynolds regime exhibit periodic variations of radial velocity. These variations are explained in terms of an helicoidal balloon motion with orbit radius approximately equal to the balloon diameter and vertical wavelength 10 to 15 times larger. Large irregular oscillations of balloon motion characterize flights with Reynolds number larger than 20,000. Author

N68-16916*# New York Univ., N. Y. School of Engineering and Science.

THE EFFECTS OF WINDS AND INHOMOGENEOUS ATMOSPHERE ON SONIC BOOMS

Y. S. Pan Jan. 1968 34 p refs

(Grant NGR-33-016-119)

(NASA-CR-92676; NYU-AA-68-1) CFSTI: HC $3.00/MF $0.65 CSCL 01B

Effects of winds and inhomogeneous atmosphere on sonic booms are studied by a shock wave-vortex sheet interaction concept. The atmosphere is assumed to be inviscid, non-conducting and constituted by a finite number of uniform parallel streams. Disturbances generated by a supersonic aircraft propagating through the atmosphere are reflected and transmitted at each interface between two streams. The last transmitted disturbances striking on the ground are reflected regularly. Propagations of a simple weak shock and an N-wave disturbance through three parallel streams are carried out. Results show that the location of the disturbance on the ground depends on the stream thicknesses and Mach numbers and the strength on the ground depends only on the stream Mach numbers. If the Mach number of the lowest stream near the ground is equal to or less than that of the first stream, the strength of the disturbance is always reduced. This conclusion is generalized to sonic booms propagating through an atmosphere constituted by a finite number of streams. Explanations of the recent sonic boom experiments at Edwards Air Force Base are given. Author

N68-17023*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

WIND-TUNNEL INVESTIGATION OF LATERAL AERODYNAMIC CHARACTERISTICS OF A POWERED FOUR-DUCT-PROPELLER VTOL MODEL IN TRANSITION

Kenneth P. Spreemann Washington Feb. 1968 76 p refs

(NASA-TN-D-4343) CFSTI: HC $3.00/MF $0.65 CSCL 01C

An investigation to determine the lateral and directional aerodynamic characteristics of a powered four-duct-propeller 1/5-scale model of a VTOL airplane was conducted in the 17-foot test section of the Langley 300-mph 7- by 10-foot tunnel. The model was tested through a sideslip-angle range at angles of attack of 0°, 8°, and 12° and with duct deflection angles from −5° to 90° at various thrust coefficients from hovering to conventional forward flight. The initial cruise configuration had neutral directional stability in the power-off-low-angle-of-attack conditions (0° and 8°) and became stable at the high-angle-of-attack condition (12°). A larger vertical tail having a higher aspect ratio than was used on the initial configuration provided a slightly stable model in the power-off condition; however, in the power-on condition, the model became unstable in the lower transition-speed range regardless of tail geometry. Tail-wing fairings of various sizes and shapes significantly increased the directional stability. Directional deflection of the elevons (vanes) in the ducts provided large control increments in roll and yaw through the transition-speed range; however, the total requirements for trim and control will necessitate the use of both elevon deflection and differential propeller thrust throughout the transition-speed range. Author

N68-17055*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

SUBSONIC AND TRANSONIC FLUTTER AND FLOW INVESTIGATIONS OF THE T-TAIL OF A LARGE MULTIJET CARGO AIRPLANE

Maynard C. Sandford, Charles L. Ruhlin, and E. Carson Yates, Jr. Washington Feb. 1968 41 p refs

(126-14-02-03-23)

(NASA-TN-D-4316) CFSTI: HC $3.00/MF $0.65 CSCL 01C

Flutter and flow studies of the T tail of a large multijet cargo airplane have been conducted in the Langley transonic dynamics tunnel at Mach numbers up to 1.08. The tail and aft fuselage of the model employed were geometrically, dynamically, and elastically scaled, whereas only the mass and stiffness characteristics of the forward fuselage, wings, and nacelles were simulated. The flutter studies included variations in fin-spar stiffness, stabilizer-pitch-actuator stiffness, rotational stiffnesses of elevators and rudder, as well as small variations in stabilizer juncture and included the use of vortex generators and fences, as well as modifications to the bullet-fairing shape. The results indicated that for a configuration with a weaker than design fin spar, the antisymmetric flutter boundary had a transonic dip amounting to a 41% reduction in dynamic pressure from the low speed value, the minimum occurring near Mach number 0.7. For the design configurations, no flutter occurred within the Mach number and dynamic-pressure ranges investigated. Separated flow over the fin and stabilizer was alleviated by the use of vortex generators, but flow over the aft portion of the bullet fairing remained separated. Author

N68-17088# Joint Publications Research Service, Washington, D. C.

CHARACTERISTICS OF AIRCRAFT CONTRAILS IN THE KIEV AREA

N. M. Mikhavlenko 13 Feb. 1968 8 p refs Transl. into ENGLISH from Tr. Ukr. Nauchn.-Issled. Gidrometeorol. Inst. (Kiev), no. 61, 1966 p 101–105
(JPRS-44353) CFSTI: HC $3.00/MF $0.65

Preliminary results are presented on an investigation on contrails utilizing data obtained by high altitude vertical–horizontal atmosphere sounding. Data are given on the effects of altitude, temperature, and high level clouds, and for both the formation and disappearance of the trails. It was found that the trails form slightly below the tropopause and generally terminate in the tropopause layer. The majority of the contrails were found to be unstable, and their densities to be variable. N.E.N.

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N68-16116*# TRW Systems, Redondo Beach, Calif.
STUDY OF THE STATE-OF-THE-ART OF THE HERMETIC SEALS FOR SECONDARY ALKALINE SPACECRAFT CELLS Quarterly Report, Sep. 20–Dec. 20, 1967
R. F. Fogle and W. R. Scott 20 Dec. 1967 25 p
(Contract NAS5-10432)
(NASA-CR-92696; QR-2) CFSTI: HC $3.00/MF $0.65 CSCL 10C

Based on vendor contacts and questioners, various hermatic seal types and manufactoring methods in commercial use are discussed. Some of the characteristics, limitations, advantages, cost and manufacturing processes of each type seal are considered. A detailed analysis of the various type seals manufactured commercially is presented. These include glass-to-metal, ceramic-to-metal, glass ceramic combinations-to-metal, rigid plastic-to-metal, elastomer-to-metal, and synthetic polymeric material-to-metal seal. A brief discussion of seals and sealing techniques not now in commercial use is given. Data show that there is no uniformity of the methods and procedures used for testing the integrity of hermetic seals. The analysis of the commercially used seals also show that these seals are not capable of meeting all the requirements for long life space cells. B.S.D.

N68-16191*# Exotech, Inc., Washington, D. C.
HANDBOOK OF SPACE ENVIRONMENTAL EFFECTS ON SOLAR CELL POWER SYSTEMS
William C. Cooley and Matthew J. Barrett Jan. 1968 243 p refs
(Contract NASw-1345)
(NASA-CR-92675; TR-025) CFSTI: HC $3.00/MF $0.65 CSCL 10A

In the design of solar cell power systems for earth satellites or interplanetary spacecraft, consideration should be given to bombardment by energetic electrons, protons, and micrometeoroids during the proposed mission, the type of solar cells, the type and thickness of shielding material, the operating voltage, and the expected operating temperature range. This handbook provides a review of research data and analytical methods which can be used to design radiation resistant silicon solar cell power systems for earth satellites which have orbits passing through the magnetosphere and for spacecraft exposed to solar flares and micrometeoroids. K.W.

N68-16228*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PERFORMANCE IN AIR OF 4-INCH-(10.16-CM-) MEAN-DIAMETER SINGLE STAGE AXIAL-FLOW TURBINE FOR REYNOLDS NUMBERS FROM 4,900 TO 188,000
Hugh A Klassen and Robert Y Wong Washington Feb. 1968 25 p refs
(NASA-TN-D-4383) CFSTI: HC $3.00/MF $0.65 CSCL 10A

A 4-inch mean-diameter turbine was investigated in air over a range of absolute inlet total pressures from 1.0 to 35.0 psia which corresponds to a Reynolds number range of 4900 to 188 000. Results were compared with those obtained for a reference 4-inch mean-diameter turbine with higher peak suction surface velocities on the stator and rotor and with higher rotor surface diffusion. Peak efficiency for the subject turbine increased from 0.40 at the lowest Reynolds number to 0.63 at the highest. The turbine had higher peak efficiencies than the reference turbine over the entire Reynolds number range. Stator- and rotor-outlet flow separation reported for the reference turbine was absent in the subject turbine except for the lowest Reynolds number of 4900, where the rotor-relative-outlet flow angle was 14° greater than design. Rotor losses were smaller than those used in the turbine design. The stator over-expansion caused by these low losses resulted in negative rotor reaction. Stator, rotor, and exit losses were computed for a blade-jet speed ratio of 0.32 and an overall static-to static-pressure ratio of 2.5. Author

N68-16239# Royal Military Coll. of Science, Shrivenham (England). Electrical Engineering Branch.
SLIP POWER RECOVERY IN AN INDUCTION MOTOR BY THE USE OF A THYRISTOR INVERTER
W. Shepherd and J. Stanway Nov. 1966 27 p refs
(RMCS-EE-R-2166)

The low-speed efficiency of an induction motor is improved by rectifying slip frequency power, inverting this to line frequency and injecting it back into the supply directly (line feedback) or through auxiliary stator windings (Stator feedback). Torque-speed curves then have the nature of a variable-speed drive. The low power factor and nonsinusoidal supply current of the line feedback connection are improved by use of the stator feedback method but the improvement of efficiency is then much less. Line feedback with a two-phase induction motor eliminates the need for a variable control voltage source. Author

N68-16321*# Douglas Aircraft Co., Inc., Newport Beach, Calif. Astropower Lab.
INORGANIC SEPARATOR FOR A HIGH TEMPERATURE SILVER–ZINC BATTERY
F. C. Arrance, R. Greve, and A. Rosa Washington NASA Feb. 1968 177 p refs
(Contract NAS3-7639)
(NASA-CR-965; SM-48461-F) CFSTI: HC $3.00/MF $0.65 CSCL 10C

The design, development and testing of a multiplate five amperehour cell are described. The fabrication of the various cell components in accordance with the cell design is discussed, and the testing and evaluation of each is described with emphasis on electrode configuration and performance. Graphs are given to illustrate results of cycling tests performed on the various cells at 30 ma/cm^2 at 25° and 100°C. Among the results from the evaluation and performance of the zinc cells constructed with inorganic separators are: (1) The 5-Ah silver–zinc cells of this type are capable of long cycle life at both 25° and 100°C. (2) The cells can be operated using KOH concentrations ranging from 30% to 45% without substantially effecting operating characteristics or cell life. (3) The inorganic separator proved its effectiveness in preventing electrode species migration, its inertness to reaction with the silver electrode, and its applicability to practical high energy density cell designs. B.S.D.

N68-16340# European Space Technology Center, Noordwijk (Netherlands).

SOLAR CELL CALIBRATION FOR AM0 (AIR MASS ZERO) SHORT-CIRCUIT CURRENT IN TERRESTRIAL SUNLIGHT

K. H. David Paris ESRO Aug. 1967 34 p refs

(ESRO-TN-5) CFSTI: HC $3.00/MF $0.65

N/P silicon solar cells were calibrated for short-circuit current at AMO sunlight by observing the circuit current produced at different zenith distances at the Solar Observatory in Locarno. Simultaneous measurements in mono chromatic light at several wavelengths between 4230Å and 9000Å permitted a check and assessment of atmospheric conditions. The accuracy of the calibrations is estimated to be about 2%. Author (ESRO)

N68-16348*# Douglas Aircraft Co., Inc., Newport Beach, Calif. Astropower Lab.

SEALING OF SILVER OXIDE–ZINC STORAGE CELLS Quarterly Report, 23 Sep.–23 Dec. 1967

23 Dec. 1967 33 p ref

(Contract NAS5-10409)

(NASA-CR-92678; DAC-59860-Q2; QR-2) CFSTI: HC $3.00/MF $0.65 CSCL 10C

Progress is reported in a program to evaluate the use of rechargeable micro fuel cells in controlling the internal pressure of secondary silver oxide–zinc cells. This will permit operating these cells in the hermetically sealed condition under a wide range of operating conditions. The fuel cells perform this function by electrochemically consuming evolved hydrogen and oxygen. Two types of cells are being used for this purpose: the first involves a silver oxide cathode in conjunction with a hydrogen consuming anode, and the second involves a cadmium anode in conjunction with an oxygen consuming cathode. Emphasis is placed on studies involved with measuring the gassing characteristics of 24 silver–zinc cells under different conditions for periods of nearly 2000 hours. Additional studies were concerned with determining the effect of charge and discharge rates on capacity. C.T.C.

N68-16351*# General Electric Co., Cincinnati, Ohio.

TWO-STAGE POTASSIUM TEST TURBINE. VOLUME 4: MATERIALS SUPPORT OF PERFORMANCE AND ENDURANCE TESTS

W. F. Zimmerman, R. B. Hand, D. S. Engleby, and J. W. Semmel, Jr. Washington NASA Feb. 1968 193 p refs

(Contract NAS5-1143)

(NASA-CR-925) CFSTI: HC $3.00/MF $0.65 CSCL 10B

The use of superalloys and refractory alloys in the fabrication and operation of a two stage potassium vapor turbine is described. Operating conditions consisted of turbine inlet vapor temperatures between 1450°F and 1550°F and rotational speeds from 15,400 rpm to 21,000 rpm during a 35-hour turbine checkout period and a 68-hour performance test period. A final steady state endurance test run of 2000 hours, of which 1750 hours were continuous, was completed at 1500°F inlet vapor temperature and at a rotational speed of 18,250 rpm. Impurity levels in the potassium were maintained at about 5–12 ppm by continuous hot trapping with zirconium foil in the boiler by-pass and condenser hot traps. Turbine components consisted of an A-286 shaft, U-700 turbine wheels, U-700, TZC and TZM blades, and L-605 nozzle partitions. The amount of contamination of various refractory alloys such as F-48, AS-30, TZM and TZC with carbon, oxygen, nitrogen and hydrogen under turbine operating conditions was evaluated and limited tensile tests were performed on refractory alloy specimens subjected to potassium vapor conditions. Overall, the turbine operation and material behavior were highly satisfactory. Author

N68-16371# European Space Technology Center, Delft (Netherlands).

DESIGN OF SOLAR CELLS WITH TWO COLLECTING JUNCTIONS

J. J. Capart Paris ESRO Nov. 1966 31 p refs

(ESRO-TN-3) CFSTI: HC $3.00/MF $0.65

Calculations are presented which predict the performances of double junction n-p-n silicon solar cells within the limits of a simplified phenomeno logical model. The influence of base thicknees and resistivity, and the resistance to space radiation environment, were analysed in greater detail. Thick double-junction cells appear poor in efficiency and radiation resistance; improved characteristics could be expected from cells with thicknesses below 50 microns. Many design problems have to be solved; some of them are discussed. Author (ESRO)

N68-16429*# Naval Ammunition Depot, Crane, Ind. Quality Evaluation Lab.

EVALUATION PROGRAM FOR SECONDARY SPACECRAFT CELLS. ACCEPTANCE TEST OF SVENSKA ACKUMULATOR AKTIEBOLAGET JUNGNER OF SWEDEN 3.9 AMPERE-HOUR NICKEL–CADMIUM CELLS

E. C. Bruess 21 Nov. 1967 21 p refs

(NASA Order W-11252-B)

(NASA-CR-92884; QE/C-67-681) CFSTI: HC $3.00/MF $0.65 CSCL 10C

Acceptance tests were performed at ambient temperature between 23°C and 27°C at existing relative humidity and atmospheric pressure on 16 Jungner secondary (3.9 ampere-hr) sealed nickel–cadmium spacecraft cells. The tests consisted of 1) a phenolphthalein test, 2) a capacity test, 3) a cell short test, 4) an immersion seal test, 5) an overcharge test, 6) an internal resistance test, and 7) an immersion seal test. Results indicate that the compression seals are satisfactory, and that the capacity of the cells was in the acceptable range of 3.90 to 4.26 ampere-hrs. It is recommended that the cells be accepted on the basis of these results. L.S.

N68-16439*# General Electric Co., Cincinnati, Ohio. Space Power and Propulsion Section.

TWO-STAGE POTASSIUM TEST TURBINE. VOLUME 2: FLUID DYNAMIC DESIGN AND PERFORMANCE

R. J. Rossbach and G. C. Wesling Washington NASA Feb. 1968 240 p refs

(Contract NAS5-1143)

(NASA-CR-922) CFSTI: HC $3.00/MF $0.65 CSCL 10A

The design, fabrication and test of a two-stage turbine suitable for operation in wet potassium vapor at temperatures of 1400 to 1600°F are reported. The test turbine consisted of stages three and four of a five-stage 500 KW turbine and had a design flow capacity of 2.8 pounds per second at 1600°F turbine inlet temperature. One principal objective of the program was to establish accurate fluid flow design methods for potassium turbines operating in the wet vapor region. The fluid flow design methods were verified when performance data measured during tests with potassium vapor agreed within five percent with values calculated prior to the tests. Author

N68-16469*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

AERODYNAMIC EVALUATION OF TWO-STAGE AXIAL FLOW TURBINE DESIGNED FOR BRAYTON-CYCLE SPACE POWER SYSTEM

Milton G. Kofskey and William J. Nusbaum Washington Feb. 1968 30 p refs

(NASA-TN-D-4382) CFSTI: HC $3.00/MF $0.65 CSCL 10B

An experimental investigation was conducted of a two-stage turbine designed to drive an alternator for a 10-kilowatt-shaft-ouput

space power system. First-stage and two-stage performance results are described for operation at approximately design Reynolds number at equivalent design speed and pressure ratio with argon as the working fluid. Tests were made at speeds ranging from 1 to 120 percent of equivalent design speed and at pressure ratios from 1.02 to 1.65. The results of the investigation indicated that, for two-stage operation, the static and total efficiencies, based on turbine-inlet and rotor-exit conditions, were 0.825 and 0.845, respectively, which compare favorably with design. The equivalent mass flow, however, was 4 percent lower than design and was attributed to the flow areas in the blade rows being smaller than design. At this point the first- and second-stage total efficiencies were 0.864 and 0.805 or approximately 2 points higher and 4 points lower than design, respectively. Two-stage performance based on turbine-inlet and collector-exit tions indicated static and total efficiencies of 0.826 and 0.835, respectively. These results, which indicate a drop in total efficiency within the collector of approximately 1 point with no change in static efficiency, compare closely with design. Author

N68-16631*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PARAMETRIC MASS ANALYSIS AND COMPARISON OF TWO TYPES OF REACTANT COOLING-AND-STORAGE UNITS FOR A LUNAR-BASED HYDROGEN-OXYGEN REGENERATIVE FUEL-CELL SYSTEM
Norman H. Hagedorn Washington Feb. 1968 34 p refs
(NASA-TN-D-4386) CFSTI: HC $3.00/MF $0.65 CSCL 13A

This study was to determine the effect of prestorage reactant cooling on the mass of a lunar-based hydrogen-oxygen regenerative fuel cell system. Consideration was given to cooling by radiators and by refrigerator–radiator combinations. Parametric mass analyses were performed for components of each cooling-and-storage unit and for the residual reactant in each tank. The combined radiative-plus-refrigerative unit has a minimum mass when the reactant is cooled to subcritical temperatures. The mass of the purely radiative unit minimizes when the reactant is cooled to within 0.5°K of the radiator sink temperature. All cooling which occurs above these optimum temperatures decreases, but does not minimize, the mass of these units. Decreasing the final storage pressure leads to considerable mass increases when the reactants are stored at supercritical temperatures. There exists an optimum allowable heat leak into the storage tanks which minimizes the total mass of the unit. For the combined unit there exists an optimum heat-rejection temperature which minimizes the sum of the masses of the solar cells and the radiator required by the refrigerator. Author

N68-16675# California Univ., Berkeley. Lawrence Radiation Lab.
PULSED POWER SUPPLY FOR ELECTROLUMINESCENT FIDUCIAL DISPLAY SYSTEM
Cordon R. Kerns 20 Sep. 1967 12 p refs Presented at the 14th IEEE Nucl. Sci. Symp., Los Angeles, 31 Oct.–2 Nov. 1967
(Contract W-7405-ENG-48)
(UCRL-17621; CONF-671026-8) CFSTI: HC $3.00/MF $0.65

A pulsed power supply has been developed which is suitable for powering electroluminescent lamps at frequencies up to 5 kHz. A distribution system for driving 90 or more lamps simultaneously and a programmed data-lamp array utilizing the power supply are also described. Author (NSA)

N68-16705*# Naval Ammunition Depot, Crane, Ind. Quality Evaluation Lab.
ANALYSIS AND EVALUATION OF SPACECRAFT BATTERY LIFE TESTS DATA
J. R. Kent Nov. 1967 75 p
(NASA Order S-23404-G)
(NASA-CR-92883; QE/C-67-592) CFSTI: HC $3.00/MF $0.65 CSCL 10C

This report presents the findings from the statistical and reliability analysis of large volumes of data on NASA spacecraft batteries. This data was generated from a life cycling test of 660 nickel-cadmium battery cells. A promising method is proposed where, after 1000 test cycles, the ultimate cycle lives of cells are predicted and the probability that an inferior cell would be rejected was estimated to be 90.5%. The probability that a good cell would be accepted was estimated to be 84.5%. The test results indicate that the number of test cycles necessary for reliable prediction may be further reduced to a few hundred cycles. Author

N68-16720# Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Aero Propulsion Lab.
INTEGRATED FIRE AND OVERHEAT DETECTION SYSTEM FOR MANNED FLIGHT VEHICLES Technical Report, Sep. 1965–Dec. 1966
Terry M. Trumble Oct. 1967 50 p
(AFAPL-TR-67-129; AD-663213)

The report describes the design of a computer for use in a unique integrated system for detecting fire and overheat in aircraft engine nacelles. This system uses ultraviolet and infrared sensors for fire detection, continuous elements for overheat detection, and the newly designed microcircuit computer for sensor analysis. The computer, operating in any of five modes -- Normal, Emergency, Ultraviolet, Infrared, or Continuous -- activates a specially designed alpha-numeric readout. Computer design criteria are firmly established, and the finalized two-channel, fail-safe, self-checking computer design is described. Boolean equations and a final schematic for the computer are given. Finally, the limitations of applying the computer from both an engineering and a legislative point of view are specified. A final flight-qualified microcircuit computer weighing 8 ounces or less, 1/2 in. by 2 in. by 5 in. in size, and drawing less than 1 watt of power can be built using the basic computer design formulated. Author (TAB)

N68-16759# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EROSION OF BLADES IN STEAM TURBINES
B. S. Dorogov 29 May 1967 87 p refs Transl. into ENGLISH of the book "Eroziya Lopatok v Parovykh Turbinakh" Leningrad Izdatel'stvo Enegiya, 1965 p 1–95
(FTD-MT-67-37; AD-663342)

The book is intended for technical personnel of design bureaus and plants and for persons concerned with problems of erosions; it may also be used by senior students in technical schools of higher education and technicians of corresponding specialties. It is a review of the present state of the problem of erosion of turbine blades based on papers published on different aspects of the problems in various countries. The causes and characteristics of the erosion of steam turbine blades, factors influencing erosion, and methods for preventing erosion are studied. The results of investigations of the erosion resistance of different metals are presented. The analogy between the erosion damage by cavitation and by impingement of drops on the surface is analyzed and the mechanism of erosion damage is investigated. Author (TAB)

N68-16882*# Radio Corp. of America, Princeton, N. J. Astro Electronics Div.
REVIEW AND EVALUATION OF PAST SOLAR CELL DEVELOPMENT EFFORTS Semiannual Report, Jun. 1–Nov. 30, 1967
P. A. Crossley, G. T. Noel, and M. Wolf Dec. 1967 225 p refs
(Contract NASw-1427)
(NASA-CR-92679) CFSTI: HC $3.00/MF $0.65 CSCL 10A

During this period, the literature search and abstraction have been continued to fill gaps in the literature previously obtained, and to keep up with new publications. The coverage of this search

is now all but complete, and such gaps as are known to exist are detailed, and the efforts made to cover these are described. A bibliography lists those papers and reports which have been read and abstracted during the reporting period. The main body of this report is a historical review of the scientific work performed on photovoltaic effects, and the development done on energy conversion devices using this effect, covering the period from 1940 to the present time. Author

N68-16914*# Electric Storage Battery Co., Yardley, Pa.
ALKALINE BATTERY SEPARATOR CHARACTERIZATION STUDIES Quarterly Report, May 23–Aug. 23, 1967
John J. Kelley 23 Aug. 1967 28 p refs
(Contract NAS5-10418)
(NASA-CR-92806, QR-1) CFSTI: HC$3.00/MF$0.65 CSCL 10C

Studies designed to evaluate in a comprehensive manner separator materials for alkaline silver batteries are reported. The primary sources of these materials are government funded projects relating to space and defense but it is planned to include all available and practical materials. The characterization tests include measures of the physical and chemical stability of the test specimens, measures of selected transport properties, an assessment of battery performance in a simplified cell design, and the production of 240 cells for evaluation. Six materials have been obtained and partially characterized during the first quarter. Author

N68-16922# Mechanical Technology, Inc., Latham, N. Y.
EXPERIMENTAL TEST AND EVALUATION OF A GAS BEARING BRAYTON CYCLE TURBOCOMPRESSOR Quarterly Progress Report, 1 Sep.–31 Dec. 1966
J. S. Meacher 6 Oct. 1967 75 p ref
(Contract AT(30-1)-3237)
(MIT-67TR74; NYO-3237-8) CFSTI: HC$3.00/MF$0.65

A Brayton cycle gas generator (turbocompressor) utilizing self-acting gas bearings was designed, built, and tested. Self-sustained closed-loop operation of the turbocompressor, using its own cycle gas as the bearing lubricant, was achieved. The turbocompressor was successfully operated in nitrogen. The turbocompressor was operated under "no-load" and "load" conditions in argon at turbine inlet temperatures up to 1355 F. A new hydrostatic-hydrodynamic thrust bearing was tested in several modes of operation. The bearing load capacity in the hydrodynamic mode fell short of theoretical prediction by a significant amount, apparently due to thermal distortion. The hydrostatic load capacity was in close agreement with theory, and was significantly greater than that of the previous bearing design. The new thrust bearing was also operated in a "self-sustained hybrid" mode, wherein the hydrostatic orifices were supplied with compressor discharge gas. The bearing successfully supported the turbocompressor rotor in this mode, over the entire design range of steady-state turbocompressor operation. Transient tests of the turbocompressor were also conducted successfully with "self-sustained hybrid" operation of the thrust bearing. The maximum ΔP achieved was 0.35 psi; turbocompressor bearing clearance at design speed operation was increased about 0.2 mil by this ΔP. Author (NSA)

N68-17029# Mechanical Technology, Inc., Latham, N. Y.
EVALUATION OF THE EFFECT OF CHANGING CYCLE GAS ON THE PERFORMANCE OF A CLOSED-LOOP BRAYTON CYCLE TURBOCOMPRESSOR
T. P. Emerson 18 Oct. 1967 59 p refs
(Contract AT(30-1)-3237)
(MTI-67TR-81; NYO-3237-9) CFSTI: HC$3.00/MF$0.65

Test data have been obtained from a closed-cycle turbocompressor-loop system using both N and Ar as the cycle working gas. It was found that when the system working fluid is changed to a thermodynamically different gas, matching of the turbine to the compressor changes. It is possible to predict analytically the change in compressor operating point from the thermodynamic properties of the gases. Compressor efficiency is primarily a function of diffuser and inducer gas angles, with Mach number playing a much less significant role. This is because the Mach number is low in this design. The compressor characteristic performance (flow parameter versus pressure ratio) can be analytically predicted with a good degree of accuracy for a change in working gas. The turbocompressor used for the test program was designed for a specific set of N operating conditions. Because of the turbine-to-compressor matching change, and a maximum turbine inlet temperature limitation, it was not possible to experimentally operate the turbocompressor at the condition of highest compressor efficiency in Ar. However, at the somewhat lower performance levels the Ar test data show reasonably good agreement with the analytically predicted Ar efficiency values based on the known compressor efficiency in N. The turbine performance in Ar was a predicted. There was no significant change in turbine efficiency (relative to N operation) when the turbo-compressor was operated in Ar. NSA

N68-17065# Radio Corp. of America, Princeton, N. J. Astro-Electronics Div.
RECOVERY FROM RADIATION DAMAGE IN SOLAR CELLS DOPED WITH LITHIUM Annual Report, Jun. 21, 1966–Jun. 20, 1967
J. J. Wysocki, G. J. Brucker, and A. G. Holmes-Siedle 20 Jun. 1967 75 p refs
(Contract NAS5-10239)
(NASA-CR-93138) CFSTI: HC$3.00/MF$0.65

The effect of lithium in producing recovery in silicon solar cells irradiated with high-energy particles was further investigated A better understanding of the processes involved is emerging; recommendations for optimizing cells for radiation resistance and suggestions for future study have been made. The main technique used to gain understanding was the study of isothermal recovery of test diodes and of government-furnished cells. Recovery appears to follow a diffusion-limited kinetic model in which unequal concentrations of the annealing species are present. It is reasonably well established that the speed and extent of recovery depend critically upon the amount of free or unpaired lithium diffusion. The damage site is still considered to immobilize lithium, and recovery is still thought to be associated with diffusion of another lithium ion to, and subsequent pairing with, the damage site. Among results which are not yet fully understood is the fact that diffusion length after bombardment is not dependent upon the initial value of lithium concentration. Author

N68-17075*# General Electric Co., Cincinnati, Ohio.
TWO-STAGE POTASSIUM TEST TURBINE. VOLUME 2: MECHANICAL DESIGN AND DEVELOPMENT
H. E. Nichols and R. W. Fink Washington NASA Feb. 1968 227 p refs
(Contract NAS5-1143)
(NASA-CR-923) CFSTI: HC$3.00/MF$0.65 CSCL 10A

This report is one of a series describing the design and development of a two-stage, Rankine cycle turbine for operation with potassium vapor. This volume presents the turbine mechanical design and describes a three-phase development test program comprising stem and air testing, potassium vapor performance testing, and a 2000-hour endurance test with turbine inlet potassium vapor at 1500°F. As part of the endurance testing, four each of TZM and TZC molybdenum blades were inserted in the second stage to observe any effects of corrosion and/or erosion. The average weight changes of the rotor blades during the endurance test were: Stage 1 (U-700), −0.304%; Stage 2 (U-700), −0.019%; Stage 2 (TYM), −0.105%; and Stage 2 (TYC), −0.102%. The testing demonstrated minimal deterioration of the turbine parts in 2100 hours of vapor operation and the feasibility of long-time operation of a potassium turbine of the design described herein. Author

N68-17084*# Philco-Ford Corp., Palo Alto, Calif. Space and Reentry Systems Div.

EXPERIMENTAL STUDY OF SOLAR CELL PERFORMANCE AT HIGH SOLAR INTENSITIES

D. C. Briggs 15 Nov. 1967 212 p refs

(Contract NAS2-4248)

(NASA-CR-73181; TR-DA-1636) CFSTI: HC $3.00/MF $0.65 CSCL 10A

An analytical and experimental program was undertaken to evaluate solar cell performance at elevated temperatures in combination with high intensity insolation. Optical characteristics of the solar cell covers were evaluated to analytically determine equilibrium temperatures for particular solar cell configurations with the cells bonded to, but thermally insulated from, a spinning spacecraft. Experimental efforts included the measurement of solar cell-cover composite performance at insolation levels approximating those encountered at 1.0, 0.5, and 0.4 A.U. The report presents a detailed investigation of solar cell performance for intensities as high as 7.6 suns for three basic types of solar cells: (1) experimental cells specifically designed for high intensity, (2) earlier production type cells, and (3) recently produced improved 2x2cm cells. The results illustrate the improvement that can be obtained in solar cell output by designing solar cells specifically for high intensity. Also illustrated is the importance of low series resistance and reduced temperature on improving solar cell performance at high intensities. Author

N68-17108*# Livingston Electronic Corp., Montgomeryville, Pa.

DEVELOPMENT OF HIGH ENERGY DENSITY PRIMARY BATTERIES Final Report, 22 Jun. 1965–21 Mar. 1967

S. G. Abens, W. C. Merz, and C. R. Walk 21 Mar. 1967 172 p

(Contract NAS3-7632)

(NASA-CR-72331) CFSTI: HC $3.00/MF $0.65 CSCL 10C

Studies of the CuF_2–Li system for the development of high energy density primary batteries were undertaken. The solubility of CuF_2 in $LiClO_4$ electrolytes increased with increasing water content. CuF_2 reduction efficiency of over 70% at 0.5 mA/cm^2 was obtained with $LiClO_4$, $LiAsF_6$, $LiBF_4$, $NaClO_4$, $NaAsF_6$, and $KAsF_6$ solutes in propylene carbonate. CuF_2–Li cells with methyl formate-$LiClO_4$ electrolyte were discharged with 60–70% cathodic efficiency at 10–20 mA/cm^2. With $LiClO_4$-propylene carbonate electrolyte, wet shelf life of four weeks was obtained at −15°C. Author

N68-17110*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

REDUCTION OF APPARENT-POWER REQUIREMENT OF PHASE-CONTROLLED PARASITICALLY LOADED TURBO-ALTERNATOR BY MULTIPLE PARASITIC LOADS

Leonard J. Gilbert Washington Feb. 1968 35 p refs

(NASA-TN-D-4302) CFSTI: HC $3.00/MF $0.65 CSCL 10B

Alternator output is improved when a phase-controlled parasitically loaded turbo-alternator has multiple sequentially actuated parasitic loads. Phase-controlled currents produce some unwanted effects. Included among these effects is an increase in the apparent-power (volt–ampere) requirement of the alternator. Phase control also produces strong harmonic components in the alternator current. The effects derive from the nonsinusoidal and reactive character of the parasitic load. The results of the analysis give the alternator apparent power and the toal harmonic content of the alternator current as a function of parasitic load. One means of reducing the unwanted effects is to subdivide the parasitic load. The analysis shows this reduction as a function of the number of divisions of the parasitic load. For the model of the circuit analysis, an undivided parasitic load produces a total harmonic content of 32 percent in the alternator current when used with a basic 0.8 lagging power factor load. But when the parasitic load is divided into two loads, the total harmonic content is reduced to 18 percent. With the same basic 0.8 lagging power factor load, the apparent power with an undivided parasitic load is 7.6 percent greater than the apparent power without a parasitic load. However, when the parasitic load is divided, this difference is only 3 percent. Additional division of the original parasitic load reduces the undesirable effects further. The amount of improvement at each division decreases appreciably with increasing number of loads, lessening the advantage obtained from load division. Author

N68-17194*# General Electric Co., Cincinnati, Ohio. Missile and Space Div.

ADVANCED REFRACTORY ALLOY CORROSION LOOP PROGRAM Quarterly Progress Report, 15 Jul.–15 Oct. 1967

R. W. Harrison, ed. 6 Nov. 1967 49 p refs

(Contract NAS3-6474)

(NASA-CR-72352; QPR-10) CFSTI: HC $3.00/MF $0.65 CSCL 10A

The fabrication and postweld annealing of all major loop assemblies was completed. Indicated high-oxygen concentrations in the distilled lithium by fast neutron activation analysis were partially a result of experimental technique. Vacuum distillation analysis has indicated an oxygen concentration of approximately 80 ppm. The program has been modified to include the construction, operation, and evaluation of a 2600°F lithium loop. ASTAR 811C oxygen contaminated specimens were prepared and capsules were formed for the advanced tantalum alloy capsule tests. Author

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

N68-16107*# Baylor Univ., Houston, Tex. Lab. of Experimental Pathology.

LIGHT AND ELECTRON MICROSCOPIC STUDY OF PRIMATE (MACACA MULATTA) LIVER AFTER LARGE DOSES OF HIGH-ENERGY (2.3 BEV) PROTONS

J. J. Ghidoni, M. M. Campbell, and H. Thomas [1967] 22 p refs

(Grant NGR-44-003-018)

(NASA-CR-92688) CFSTI: HC $3.00/MF $0.65 CSCL 06R

Morphological data are presented on a series of experiments in which the livers of seven primates were exposed to high-energy protons which penetrated the whole animal. Data were collected at intervals of 15 minutes, 6, 12, 18, 24, 36, and 48 hours after irradiation with 2.3 Bev protons. The results of the electron microscopic studies performed on the irradiated primate liver at these time intervals are discussed. The progressive increase in hepatic lipid which was first noted at 15 minutes and persisted until 24 hours, after which it leveled off and decreased sharply, is considered a significant finding. Small cytoplasmic clefts, the number of dark cells in the post-irradiation tissue, and mitochondrial alterations are also mentioned. Pictures are presented to illustrate the various findings which are considered. B.S.D.

N68-16109*# Public Health Service, Cincinnati, Ohio.

ECOLOGY AND THERMAL INACTIVATION OF MICROBES IN AND ON INTERPLANETARY SPACE VEHICLE COMPONENTS Quarterly Progress Report, Oct. 1–Dec. 31, 1967

Robert Angelotti Jan. 1968 36 p refs
(NASA Order R-36-015-001)
(NASA-CR-92720; QPR-11) CFSTI: HC $3.00/MF $0.65 CSCL 06M

Techniques are described for measuring the dry heat resistance of *B. subtilis* var. *niger* spores in and on various materials. The D and z values are presented for these spores in the various test systems, in which the D value is the rate of death of an organism at a given temperature, and the z value is a measure of the change in rate of destruction with temperature. The systems tested included spores located on steel and paper strips, spores between stainless steel washers mated together under 150 in.-lbs and 12 in.-lbs. of torque, and spores encapsulated in methylmethacrylate and epoxy plastics. An explanation of the differences in heat resistance as related to the materials in or on which spores are located is offered. The results indicate that the dry heat resistance of *B. subtilis* var. *niger* are influenced by the initial moisture content of the spores, the rate of spore desiccation during heating, and the equilibrium relative humidity of the system. B.S.D.

N68-16115*# California Univ., Los Angeles. Space Biology Lab.
EFFECTS OF LOW LEVEL, LOW FREQUENCY ELECTRIC FIELDS ON HUMAN REACTION TIME
James R. Hamer [1967] 13 p refs
(Grant NsG-237)
(NASA-CR-92700) CFSTI: HC $3.00/MF $0.65 CSCL 06S

Details are given on the experimental apparatus and the procedures used in the testing of human reaction time (RT) at different electromagnetic field frequencies. Reaction times were measured at different frequencies but with a constant field strength and a sinusoidal electric field to ensure that changes in reaction time were the result of the different applied frequencies. The procedures adopted as controls for individual differences, and to assure experimental sensitivity are presented in detail. The testing of the subjects at various intervals is described. The collected data were analyzed to show the effect of variability in RT performance on the results of the experiment. Findings show that low level, low frequency electric fields can affect human RT performance. The experimental design used emphasized that the effects are frequency sensitive and not due merely to the presence of the field. B.S.D.

N68-16130*# National Aeronautics and Space Administration, Washington, D. C.
DISTINCTIONS OF AUDITORY ANALYZER FUNCTIONS DURING PROLONGED EXPOSURE OF MAN TO CHANGED GAS ENVIRONMENT [OSOBENNOSTI FUNKTSII SLUKHOVOGO ANALIZATORA PRI DLITEL'NOM PREBYVANII CHELOVEKA V USLOVIYAKH IZMENENNOY GAZOVOY SREDY]
Ye. M. Yuganov, Yu. V. Krylov, and V. S. Kuznetsov Dec. 1967 5 p refs Transl. into ENGLISH from RUSSIAN Presented at the 18 Congr. of the Intern. Astronautical Federation, Belgrade, 25–30 Sep. 1967
(NASA-TT-11396) CFSTI: HC $3.00/MF $0.65 CSCL 06S

The auditory analyzer function of man was studied during prolonged exposures to barometric pressures of 308 mm Hg with normal partial oxygen pressure; and effects of an atmosphere containing up to 2% carbon dioxide as well as those of a helium–oxygen mixture were investigated. Both dynamic audiometry and reverse auditory adaptation time failed to reveal deviations greater than the usual physiological fluctuations. At an auditory threshold fluctuation under 10 to 15 db there was stable adaptation to new conditions, but with 20 to 25 db there appeared to be a depletion of adaptation mechanisms. It was concluded, however, that the human auditory analyzer had significant resistance during prolonged exposure to artificial atmospheres with altered gas environments. M.W.R.

N68-16183*# National Aeronautics and Space Administration, Washington, D.C.
FURTHER INVESTIGATIONS OF THE COMPLEX EFFECT OF IONIZED RADIATION AND ACCELERATIONS ON THE ORGANISM AS RELATED TO SPACE FLIGHTS [DAL'NEYSHIYE ISSLEDOVANIYA KOMPLEKSNOGO VOZDEYSTVIYA NA ORGANIZM IONIZIRUYUSHCHEGO IZLUCHENIYA I USKORENIY V SVYAZI S KOSMICHESKIMI POLETAMI]
V. V. Antipov, B. I. Davydov, E. F. Panchenko, and P. P. Saksonov Dec. 1967 11 p refs Transl. into ENGLISH from Russian Presented at the 18th Congr. of the Intern. Astronautical Federation, Belgrade, 25–30 Sep. 1967
(NASA-TT-11397) CFSTI: HC $3.00/MF $0.65 CSCL 06R

Permissible irradiation doses during exposure to space flight factors, are evaluated, with emphasis placed on the role of recovery processes in the irradiated organism's reaction to critical accelerations. Data obtained from animals exposed to various doses revealed that there are common patterns in the reactions of irradiated animals to extreme accelerations and repeated irradiation. Experimental data were extrapolated to obtain man's tolerance for extreme accelerations at different irradiation doses. In evaluating the extrapolation, it was determined that at doses of 50–90 rem (roentgen equivalent, man) human tolerance of accelerations after exposure to such doses will apparently not differ appreciably from that of healthy individuals for a period of 200 days after irradiation. B.S.D.

N68-16189# Federal Aviation Administration, Oklahoma City, Okla. Civil Aeromedical Inst.
IN-FLIGHT PHYSIOLOGICAL MONITORING OF STUDENT PILOTS
C. E. Melton and Marlene Wicks Aug. 1967 13 p refs
(AM-67-15) CFSTI: HC $3.00/MF $0.65

Records of heart rate (ECG), lateral eye movements (EOG) and vocal interchange between student and instructor were taken on magnetic tape during all of every flight throughout a conventional private pilot training syllabus. Six men (33–45 years of age) and two women (29 and 28 years of age) were studied. Heart rates were higher on solo (112 bpm) than on dual flights (106 bpm) and higher on check flights than on solos (120 bpm). Heart rate increased at takeoff on solo flights but did not change or decrease on dual flights. Resulting heart rate was a predictor of the type of flight to be undertaken, being higher before solo than before dual flights and highest before check flights. Over the entire syllabus in-tight heart rates showed increases corresponding to the two main goals of the student, i.e., first solo and the check flight, with a plateau between the two events. Low airspeed maneuvers gave rise to the highest heart rates for every subject. Frequency of eye movements was higher on solo than on dual flights and was characteristic for each subject. Heart rates of these student pilots were as high as or in some cases higher than those required for X-15, lifting body, high-performance jet, and carrier-based combat pilots, and, indeed, astronauts. Author

N68-16190*# Techtran Corp., Glen Burnie, Md.
LIFE IN SPACE—NEW ADVANCES IN SPACE BIOLOGY [LEBEN IM WELTRAUM—NEUE ERGEBNISSE DER EXOBIOLOGIE]
Feb. 1968 7 p Transl. into ENGLISH from German
(Contract NASw-1695)
(NASA-TT-F-11540) CFSTI: HC $3.00/MF $0.65 CSCL 06C

Recent results of scientific research in space have not only given new force to the old question of traces of life on celestial bodies, but have also led to studies of how living organisms are influenced by the conditions of space. This paper contains an interview with the Chairman of the Study Group for Biophysical Space Research at Frankfurt/Main, Germany, Dr. H. Bucker, concerning the present state of knowledge in this field. Author

N68-16274*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif. Naval School of Aviation Medicine, Pensacola, Fla.

CARDIAC OUTPUT AND REGIONAL BLOOD FLOW IN CONSCIOUS RATS EXPOSED TO ACUTE HYPOXIA

N. S. Nejad, Thomas N. Fast, and Eric Ogden 15 Nov. 1967 17 p refs Prepared jointly with Naval School of Aviation Med.

(NASA-TM-X-60839; NAMI-1026) CFSTI: HC $3.00/MF $0.65 CSCL 06C

The effects of hypoxia on cardiac output and fractional distribution of regional blood flow were measured in unrestrained and unanesthetized Sprague–Dawley rats. Cardiac output was determined by thermodilution techniques, while blood distribution was determined by Rb^{86} Cl and iodoantipyrine I^{131} tracers. The animals were exposed to 18–24 hours after cannulation to atmospheres of air and of 7 to 10% oxygen in nitrogen. Cardiac output was higher in the hypoxic environments. Fractional distribution to brain, heart, and adrenal was increased, while that to the kidney and spleen was decreased in reduced O_2 environments. Author

N68-16307# Martin Co., Denver, Colo.

TECHNOLOGY FEASIBILITY SPACECRAFT (TFS). VOLUME 4: STERILIZATION AND BIOASSAY Final Report

R. McKinney Feb. 1968 49 p refs

(R-68-2, V. 4)

Bioassay techniques, ultraclean handling, and terminal heat sterilization work on a feasibility, full-scale, semifunctional model spacecraft are discussed. The model is a thermal equivalent of a typical planetary lander vehicle. Study aims were to obtain data on the degree of biological contamination during manufacturing and test sequences. Results are given for Swab, Radac, and coupon sampling bioassay studies. Partial results are given for the ultraclean handling and terminal heat sterilization studies. These efforts were curtailed due to budget and schedule limitations. Study results show that major contamination comes from human contact and handling, with only a minor amount from air; maufacturing cleaning processes are highly lethal for biota, producing a significant short term reduction in biota count; the total microbial burden at the end of this program was 1×10^7 microorganisms, well below the required level for entering terminal sterilization. The statistical analysis techniques followed in processing the bioassay data are also included. E.C.

N68-16389*# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.

[BIOMECHANICS WITHIN THE FIELD OF CARDIOVASCULAR PHYSIOLOGY] Semiannual Progress Report, 1 Jul.–31 Dec. 1967

Max Anliker 31 Dec. 1967 14 p refs

(Grant NGR-05-020-223)

(NASA-CR-92999; SAPR-1) CFSTI: HC $3.00/MF $0.65 CSCL 06P

Investigations on the effects of various parameters and properties of the cardiovascular system on the transmission characteristics of sounds and pressure pulses are reported. Determinations are made of the elastic properties of arteries and veins and the changes of these properties under physical and physiological stresses that may for example be produced by trauma, prolonged weightlessness, or acceleration. Studies are made of the mechanical behavior of the circulatory system and its control mechanisms, and methods are developed for measuring the changes in the elastic properties of blood vessels in man that do not require the penetration of the skin. Included are summaries of work accomplished in (1) the effects of pressure on dispersion and attenuation of waves in the aorta, (2) new techniques for studying the elastic behavior of the heart and large arteries and veins, (3) intravascular transmission characteristics of artificially induced heart sounds, and (4) transmission characteristics of axial waves in blood vessels. C.T.C.

N68-16402# Directorate of Aerospace Safety, Norton AFB, Calif. Aero Medical Safety Div.

AIRCRAFT ACCIDENT INJURIES: A REVIEW OF OVER 2,000 CASES

H. G. Moseley 1967 24 p Presented at the 28th Ann. Meeting of the Aero Med. Assoc., Denver, 6–8 May 1967

(M-12-57; AD-663760)

During the calendar years 1953 and 1955, over 8,000 personnel were involved in major USAF aircraft accidents. Eighteen and seven-tenths per cent of these occupants received fatal injuries and 5.2% received major injuries. However, 76.1% received minor or no injury. Most fatalities were due to multiple traumatic lesions. Most major nonfatal lesions were fractures, especially of the vertebrae. However, burns and surface wounds were frequent. The head and the distal third of the extremities received the majority of injuries and were associated with flailing of these unsecured body portions during deceleration. Concerning deceleration, when impact forces were moderate or negligible, there were few injuries; when impact was severe, injury was frequent and often fatal; when it was extreme, fatal results were the rule. In all accidents there was increased injury if the seat tore loose or if the seat belt was not used. If the occupant was in a seat facing the rear of the aircraft, he was less liable to be injured than if he faced forward. This was especially true in low impact accidents where the seat was more liable to remain moored to the floor. Author (TAB)

N68-16419*# Ohio State Univ., Research Foundation, Columbus. Environmental Medicine Lab.

CARDIOVASCULAR EFFECTS OF VIBRATION Semiannual Report, Jul. 1–Dec. 31, 1967

Lester B. Roberts 6 Feb. 1968 116 p refs

(Grant NGR-36-008-041)

(NASA-CR-92887; Rept.-4) CFSTI: HC $3.00/MF $0.65 CSCL 06S

Electrocardiograms were obtained from each of six male subjects during vibration, and recorded on magnetic tape. The data are being given careful clinical evaluation. Selected portions of the data from two subjects have been transcribed as X, Y, and Z axis orthogonal strip chart recordings. Portions of the recorded data were averaged using computer techniques previously described. These transcribed and averaged data, together with pertinent observations, are presented. Another digital computer program useful for averaging electrocardiogram signals is also described. L.S.

N68-16452# Joint Publications Research Service, Washington, D. C.

AUTOMATIC DECIPHERING OF BALLISTOGRAMS WITH USE OF COMPUTERS

G. I. Sidorenko and G. A. Afanas'yev 21 Feb. 1968 10 p refs Transl. into ENGLISH from Kardiologiya (Moscow), no. 12, Dec. 1967 p 117–123

(JPRS-44460) CFSTI: HC $3.00/MF $0.65

The use of computer data processing methods and the applications of random processes and information theories are proposed for analyzing ballistocardiograms (BCG). The effects of periodic signal magnitude and random noise on the signal-to-noise ratio, and the possibility of masking the BCG signal, are discussed. An autocorrelation analysis method is described in which the most important characteristic of the BCG can be obtained. Data from the BCG analysis of healthy persons are illustrated to show that the initial oscillation corresponds to the sum of the correlation functions of the signal and the noise. It is also shown that the autocorrelation function of the BCG may be used to estimate the mean values of the periodic signal in terms of its basic harmonic, the variability of the signal in terms of dispersion, and perhaps the properties of inertness of circulatory self-regulation. It is pointed out that the autocorrelation function offers significantly more information than the oscillography, since it is based on an analysis of the statistical properties of random processes. M.G.J.

N68-16473# Joint Publications Research Service, Washington, D. C.
SPACE CARDIOLOGY AND SOVIET ADVANCES IN CARDIAC SURGERY
21 Feb. 1968 9 p refs Transl. into ENGLISH from Kardiologiya (Moscow), no. 11, Nov. 1967 p 13–18
(JPRS-44463) CFSTI: HC $3.00/MF $0.65

The reactions of the cardiovascular system in the different stages of space flight are examined from the viewpoint that the body is a system which performs two types of regulation: achievement of a balance with the external environment, or cortical regulation; and maintenance of homeostasis, or autonomic regulation. Experimental and actual flight data are discussed in relation to the effects observed during the prelaunch state, the powered phase of the flight, orbital flight, and extravehicular activity performance. It is recommended that the clinical aspects of space cardiology include (1) study of disturbances which may arise in space flight due to weightlessness and other critical factors; (2) establishment of criteria for selecting cosmonauts and training them in accordance with the condition of their cardiovascular system; (3) study of problems relating to the diagnosis and treatment of diseases and disorders that may arise during prolonged flight; and (4) use of clinical data to interpret the results of examinations during space flight. M.G.J.

N68-16502# Oregon State Univ., Corvallis.
THE ROLE OF NATURALLY OCCURRING QUINONES IN PHOTOSYNTHESIS Yearly Progress Report, 1 Sep. 1966–1 Sep. 1967
Norman I. Bishop 1 Sep. 1967 9 p refs
(Contract AT(45-1)-1783)
(RLO-1783-13) CFSTI: HC $3.00/MF $0.65

Progress is reported in studies on the effects of uv radiation on photoreactions of green algae and chloroplasts and quinones isolated from Scenedesmus. Results indicated that the site of uv inhibition is prior to the site of plastoquisnone action in the electron transport chain. Vitamin K substances were isolated from the blue-green algae *Anacystis nidulans*, which possesses only plastoquinone A and two vitamin K type compounds. NSA

N68-16517*# National Aeronautics and Space Administration, Washington, D. C.
AEROSPACE MEDICINE AND BIOLOGY Continuing Bibliography With Indexes, During December 1967
Jan. 1968 130 p refs
(NASA-SP-7011(45) CFSTI: HC $3.00/MF $0.65 CSCL 06S

Subject coverage concentrates on the biological, physiological, psychological, and environmental effects to which man is subjected during and following simulated or actual flight in the earth's atmosphere or in interplanetary space. References describing similar effects on biological organisms of lower order are also included. Such related topics as sanitary problems, pharmacology, toxicology, safety and survival, life support systems, exobiology, and personnel factors receive appropriate attention. Each entry consists of a standard citation accompanied by its abstract. Author

N68-16538# School of Aerospace Medicine, Brooks AFB, Tex.
B-52D MOBILE FLIGHT SIMULATOR FLASHBLINDNESS EXPERIMENT, JULY 1966–MARCH 1967
James E. Hamilton Sep. 1967 15 p refs
(SAM-TR-67-67; AD-663230)

Thirty-five B-52 pilots were used in a study to obtain quantitative performance data on the effect of flashblindness on aircraft control and to measure visual recovery time from flashblindness during a series of flights in the B-52D mobile aircraft simulator. A Honeywell Strobonar model 65-C flashlamp was mounted in front of the pilot in order to produce flashblindness under simulated nighttime cockpit conditions. Data on aircraft attitude or recovery time were analyzed at four 6-second intervals and at recovery time after the flash. The effect of flashblindness on aircraft control was measured by the comparison of control (nonflashed) and experimental (flashed) flights. The variables analyzed were bank error (deviation from 30 degrees), indicated airspeed error (deviation from 270 knots), pitch error (deviation from 0 degrees), altitude error (deviation from 6 km. (20,000 ft.)), and recovery time (seconds). Author (TAB)

N68-16564# Nuclear Utility Services, Inc., Washington, D. C. Environmental Safeguards Div.
DOSE CALCULATION MODELS FOR RE-ENTERING NUCLEAR ROCKET DEBRIS
Albert W. De Agazio Jan. 1967 51 p refs Revised
(Contract SNPC-6)
(NUS-229, Rev.) CFSTI: HC $3.00/MF $0.65 CSCL 06R

Estimation of the biological hazards resulting from nuclear rocket engine flight failures is complicated by the more or less random nature of the deposition of engine debris into the biosphere. The probability of indirect exposure through ingestion is directly related to the likelihood of the debris falling on cultivated land. The external dose functions and external and internal dose probability functions are derived in this report. External whole body gamma and beta dose relationships are derived for receptors who are mobile; i.e., who are not fixed in a given location for the entire exposure period. The probability of receiving at least a given external dose, the fraction of the population receiving at least a given dose and the overall population dose are also derived for external gamma radiation exposures. The functions for determining the probability of a receptor being struck by a particle that sticks to the skin and the number of people so affected are derived to allow estimation of the hazard from localized beta doses to the skin. Internal dose probability functions are derived for both ingestion and inhalation. These relations consider cultural influences such as diet, agricultural production, and population density. Comparisons are made to fallout from nuclear weapon testing and subsequent appearance of ^{90}Sr and ^{137}Cs in food in the United States. NSA

N68-16585*# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.
CHEMICAL FOOD SYNTHESIS SYSTEMS FOR SPACECRAFT
E. Gene Lyman [1967] 24 p refs Presented at the Closed Ecol. Session, Ann. Meeting of the Am. Inst. of Chem. Eng., N. Y., 28 Nov. 1967
(NASA-TM-X-60861) CFSTI: HC $3.00/MF $0.65 CSCL 06H

The life support system requirements for long duration manned space missions were examined. Hybrid systems that use both biological and chemical processes for food synthesis from metabolic wastes may be feasible and competitive with systems that use stored food. A typical, conceptual, configuration of a closed life support system is described. Specific processes for the synthesis of formaldehyde, glycerol, carbohydrates, and ethanol are discussed. Work currently under way to develop technology suitable for synthesis of such materials is briefly described. Author

N68-16584# Joint Publications Research Service, Washington, D. C.
CYBERNETICS IN BIOLOGY AND MEDICINE
V. Parin, Ye. Geller, A. Malinovskiy, and V. Svintsitskiy 20 Feb. 1968 13 p Transl. into ENGLISH from Kommunist (Moscow), no. 1, Jan. 1967 p 69–79
(JPRS-44432) CFSTI: HC $3.00/MF $0.65

The basic concepts of cybernetics are reviewed, and the way in which the control process takes place is examined. The development of biocybernetics is discussed in terms of the application of theoretical and mathematical methods to the specifics of biological phenomena. Two approaches to biological modeling are examined: actual biological modeling of a process for the purpose

of checking the correctness of the concepts against it; and bionic modeling of the same process for the purpose of subsequently developing a technical system capable of fulfilling similar functions. Basic research trends in biocybernetics are surveyed, and several examples of experimental studies are presented. The growing importance of medical cybernetics is emphasized. The point is made that the general principles of cybernetics permit a more profund and precise analysis of unknown phenomena, and create a more sophisticated, synthetic pattern of the evolutionary process and of the structure of organisms. M.G.J.

N68-16595# School of Aerospace Medicine, Brooks AFB, Tex.
FURTHER RESEARCH INTO THE EFFECT OF IONIZING RADIATION COMBINED WITH G-LOADING DURING SPACE FLIGHT [DAL'NEYSHIE ISSLEDOVANIYA KOMPLEKSNOGO VOYDEYSTVIYA NA ORGANIYM IONIYIRUYUSHGHEGO IZLUCHENIYA I USKORENIY V SVYAYI S KOOMICHESKIMI POLETAMI]
V. V. Antipov, B. I. Davydov, E. F. Panchenkova, and P. P. Saksonov Sep. 1967 20 p refs Transl. into ENGLISH from Russian Presented at 18th Congr. Intern. Astronautical Federation, Belgrade, 25–30 Sep. 1967
(SAM-TT-R-941-1267; AD-663197) CFSTI: HC $3.00/MF $0.65

Material is revealed representing further development in the research into the responsiveness of an irradiated organism to various spaceflight factors. In particular, an attempt was made to evaluate the role of processes arising within the irradiated organism as it responds to chronic G-loading. Principles concerning the feasibility of extrapolating our experimental results to man are outlined as well as the manner in which orientational data was collected on the maximum possible exposure (MPE) as evaluated in the light of criteria for acceleration tolerance. TAB

N68-16617*# California Univ., Berkeley. Dept. of Nutritional Sciences.
DEVELOPMENT OF A SEMIPURIFIED DIET FOR THE ADULT POCKET MOUSE (PEROGNATHUS)
Gene A. Spiller and Rosemarie Ostwald [1967] 17 p refs
(Grant NGR-05-003-118)
(NASA-CR-92835) CFSTI: HC $3.00/MF $0.65 CSCL 06C

A semipurified diet has been developed for the pocket mouse *(Perognathus longimembris* and *P. penicillatus)*, small desert rodents that do not drink water. The key difference between this diet and a standard semipurified mouse diet is the mineral composition. The ratio of K/Na and Mg/Ca is high and the inorganic phosphates are replaced by the calcium, magnesium and sodium salts of glycerophosphates. The adequacy of this diet has been shown by the maintenance of over 100 pocket mice for 6 months without weight loss, with a normal behavioral pattern and in apparent good health. Carcass composition and the size and microscopic appearance of organs were the same for animals on this diet as compared with animals fed their customary mixed seed diet. Author

N68-16622# Brookhaven National Lab., Upton, N. Y.
THE CELLULAR BASIS OF ACUTE RADIATION DEATH IN THE MAMMAL
Victor P. Bond 8 Feb. 1967 15 p refs Sponsored by AEC
Its Lecture Ser. No. 63
(BNL-50064(T-485) CFSTI: HC $3.00/MF $0.65

The effects of radiation delivered to the entire body are described, and conditions under which such exposure of human beings may be encountered were outlined. It was demonstrated that the complicated clinical picture seen as the result of such exposure has its genesis primarily in the depletion of cellular elements in the peripheral blood. It was further shown that the time course and dose relationships seen can be explained satisfactorily on the basis of the kinetics of the cell populations involved and the known cellular radiobiology that pertains to these cell populations. Additional implications of the cellular approach are described, and some practical applications are given, e.g., in devising rational therapy and in dealing with some of the radiation problems potentially affecting space travel. Throughout, emphasis was placed on the fact that the body is normally in a state of dynamic cellular equilibrium, in some small measure like an airplane in flight. Some perturbations of the systems can be adjusted to or corrected for. Severe or serious perturbation, however, results in disease or even death if equilibrium is not reestablished in time. Radiation is but one of the many harmful agents that can upset the cellular equilibrium and lead to serious illness and death. Author (NSA)

N68-16640*# National Aeronautics and Space Administration, Washington, D. C.
INVESTIGATION OF LONG-TERM EFFECT OF A REDUCED PRESSURE OXYGEN ATMOSPHERE ON ANIMALS AND MAN [ISSLEDOVANIYE DLITEL'NOGO VOZDEYSTVIYA NA ZHIVOTNYKH I CHEKOVEKA KISLORODNOY ATMOSFERY S PONSIZHENNYM DAVLENIYEM]
A. M. Genin, S. G. Zharov, Ye. Ya. Kaplan, V. V. Ogleznev and V. I. Solov'yev Dec. 1967 10 p refs Transl. into ENGLISH from RUSSIAN Presented at the 18th Congr. of the Intern. Astronautical Federation, Belgrade, 25–30 Sep. 1967
(NASA-TT-F-11400) CSCL 06S

The effect of a 15- to 30-day confinement in a gas medium with a high oxygen content and a pressure corresponding to between 7,000 and 10,000 m was studied on both animals and human beings. A total of 1,000 white mice, 500 rats, and 8 rabbits were subjected to stays at various lengths under various simulated altitudes in atmospheres containing between 87 and 98% oxygen. Significant changes in behavior or reflex action were not evidenced following 30-day stays in 87% oxygen atmosphere at altitudes corresponding to 7,000 m; and, although there were no morphological changes in internal organs, there were temporary lung collapses in some of the animals. At a simulated altitude of 11,500 m moderate hypoxia set in and there was increased activity in vital organs as well as longer duration of motor reflexes. Again, there were no clearly expressed morphological changes. Mnetal and physical work capabilities of five humans did not change significantly following 30-day stay in 90 to 94% oxygen at pressures corresponding to 7,000 and 10,000 m, although there was evidence of general sluggishness. M.W.R.

N68-16643*# National Aeronautics and Space Administration, Washington, D. C.
EFFECT OF PROLONGED (62-DAY) HYPOKINESIS ON THE HUMAN ORGANISM [VLIYANIYE 62-SUTOCHNOY GIPOKINEZII NA ORGANIZM CHELOVEKA]
T. V. Benevolenskaya, M. M. Korotayev, T. N. Krupina, I. A. Maslov, G. P. Mikhaylovskiy et al Dec. 1967 5 p Transl. into ENGLISH from RUSSIAN Presented at the 18th Congr. of the Intern. Astronautical Federation, Belgrade, 25–30 Sep. 1967
(NASA-TT-F-11399) CFSTI: HC $3.00/MF $0.65 CSCL 06S

Effects of a 62-day period of bed confinement on six generally healthy young men between the ages of 23 and 36 are described. All subjects were permitted movements in the horizontal position, and three of the men were engaged in a special program of daily exercise. Disturbances were noted in all of the systems and organs of all the men, although difficulties varied among the systems and the men. The most marked disturbances were noted in men who exhibited some difficulties prior to the initiation of the experiment; for example, two nosebleeds occurred in subjects with a slight dryness of the nasal mucous membrane, angina occurred in a subject with chronic tonsillitis, and psychological changes were more pronounced in men who had previous peculiar behavior patterns. M.W.R.

N68-16644*# National Aeronautics and Space Administration, Washington, D. C.

PRESENT STATUS AND TRENDS IN INVESTIGATION OF THE HUMAN CARDIOVASCULAR SYSTEM IN SPACE FLIGHTS

I. T. Akulinichev, V. A. Degtyarev, and D. G. Maksimov Dec. 1967 7 p refs Transl. into ENGLISH from Russian Astronautical Federation, Belgrade, 25–30 Sep. 1967

(NASA-TT-F-11395) CFSTI: HC$3.00/MF$0.65 CSCL 06S

An overview of studies dealing with the testing and responses of the cardiovascular system during space flights is presented. Various results of functional tests are noted, and the importance of such tests on a regularly scheduled basis and in conjunction with central nervous system and work capacity tests is stressed. It is suggested that standardization of both test methods and information processing be implemented, and that efforts made in relation to space medicine would have applicability to clinical practice. M.W.R.

N68-16719*# Aerojet-General Corp., Azusa, Calif.

INTERCHANGE OF GROUP C BETA HEMOLYTIC STREPTOCOCCI AMONG DOGS AND MONKEYS CONFINED IN DYNAMIC FLOW ATMOSPHERIC SYSTEMS

James G. King, 3 Wright-Patterson AFB, Ohio AMRL Sep. 1967 17 p refs Sponsored in part by NASA

(Contract AF 33(657)-11305)

(NASA-CR-92662; AMRL-TR-66-182; AD-663217) CFSTI: HC $3.00/MF$0.65

Serial throat and rectal bacteriological samples were taken from closely confined animals in dynamic flow atmospheric chambers during toxicology experiments at both altitude and ambient conditions to measure the extent of bacterial interchange in environments similar to those in space cabins. Dogs and monkeys were exposed for prolonged periods to 0.2 mg/cu m ozone in air at 740 mm Hg, to 100% oxygen at 260 mm Hg, and to ambient conditions. The incidence of isolation of Lancefield group C beta hemolytic streptococci increased from 25 to 91%. Because of this increased rate of isolation of serologically uniform beta hemolytic streptococci, transfer of this organism between animals is postulated. The effects of confinement on bacterial interchange in this particular set of atmospheres are discussed. Author (TAB)

N68-16751# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DOSIMETRY AND PROTECTION FROM IONIZING RADIATION

B. P. Golubev 1 May 1967 305 p refs Transl. into ENGLISH of the book "Dozimetriya i Zashchita ot Ioniziruyushchikh Izlucheniy" Moscow, Gosenergoizdat., 1963 p 1–336

(FTD-MT-64-291; AD-663372)

Consideration is given to different methods of ionizing radiation dosimetry and simplified methods for design of shielding for gamma radiation, for neutron radiation and for design of shielding in a nuclear reactor. TAB

N68-16753# Federal Aviation Agency, Oklahoma City, Okla. Dept. of Transportation.

ADAPTATION TO VESTIBULAR DISORIENTATION. 6: EYE-MOVEMENT AND SUBJECTIVE TURNING RESPONSES TO VARIED DURATIONS OF ANGULAR ACCELERATION

Fred E. Guedry and William E. Collins May 1967 12 p refs

(AM-67-7)

Turning sensations and eye movement responses during angular accelerations may show adaptation effects of significance to understanding vestibular reactions during certain aircraft maneuvers. In this study, a direct relationship found between duration of acceleration and (a) decline of response during acceleration, (b) rate of decline of response after acceleration, and (c) magnitude of secondary reaction, is regarded as an indication of a central process which limits a prolonged vestibular primary reaction. The process is manifested by its influence on relatively basic reflex reactions (nystagmus) in the cat, and is more prominently manifested in man by its influence on sensory perception. Author

N68-16821# Universidad Nacional de Trujillo (Peru). Departamento de Fisiologia.

THE OLE OF CATECHOLAMINES AND SEROTONIN IN THE PROCESS OF ADAPTATION TO HIGH ALTITUDE

A. Medina, L. Utano, and G. Olaya [1967] 6 p refs

(Grant AF-AFOSR-888-66)

(AFOSR-67-2735; AD-662631) CFSTI: HC $3.00/MF $0.65

The effects of hypoxia (12.85% O2 in N2) on the pulmonary artery pressure of dogs were studied, as well as the variations in the level of serotonin in the blood of the same artery. Hypoxia produced pulmonary hypertension in the 7 dogs studied, and at the same time an increase in the level of serotonin in the blood of the pulmonary artery was produced. This result is expounded in relation to a reflex vasoconstriction which is mediated by serotonin. Author (TAB)

N68-16830*# National Aeronautics and Space Administration, Washington, D. C.

CHANGES IN THE TOLERANCE OF MAN TO TRANSVERSE ACCELERATIONS

A. R. Kotovskaya, R. A. Vartbaronov, and S. F. Simpura Dec. 1967 13 p refs Transl. into ENGLISH of the Rept. "Izmeneniye Perenosimosti Chelovekom Poperechnykh Peregruzok Posle Gipodinamii Razlichnoy Orodolzhitel'nosti" Presented at the 18th Congr. of the Intern. Astronautical Federation, Belgrade 25–30 Sep. 1967

(NASA-TT-F-11401) CFSTI: HC$3.00/MF$0.65 CSCL 06S

A summary is presented of investigations on human tolerance to transverse accelerations after hypodynamia under conditions of a strict bed regime with a duration of 3.7, 20, and 60 days. The experiments were conducted on 20 healthy individuals who had been subjected to a special clinical examination. Tolerance was evaluated on the basis of the maximum magnitude of acceleration acting in a chest-back direction at an angle of 80° and 65°. The principal criterion of tolerance under the influence of accelerations at an angle of 80° was the appearance of relative bradycardia, and less frequently visual and respiratory disorders. At an angle of 65° it was primarily visual disorders. The collected data on the tolerance to accelerations and physiological reactions were statistically processed by the differences method using the linear unidirectional regression technique. The indices of the physiological reactions of the subjects were compared as a result of the imparting of accelerations of different magnitude with respect to their absolute values and with the initial levels taken into account. The results are shown and discussed. R.N.A.

N68-16895# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

RESULTS OF INVESTIGATION OF THE EFFECT OF COSMIC RADIATION AND OTHER FACTORS OF COSMIC FLIGHT ON LYSOGENIC BACTERIA AND HUMAN CELL CULTURES [ITOGI ISSLEDOVANIYA VLIYANIYA KOSMICHESKOY RADIATSII I DRUGIKH FAKTOROV KOSMICHESKOGO POLETA NA LIZOGENNYYE BAKTERII I KLETKI CHELOVEKA V KUL'TURE]

N. N. Zhukov-Verezhnikov and I. N. Mayskiy 24 Jul. 1967 9 p Transl. into ENGLISH from Akad. Nauk SSSR. Izv. Ser. Biol. (USSR), no. 4, 1966 p 592–593

(Contract AF 33(657)-16409)

(FTD-HT-67-200; AD-663360)

Single-layer cultures of normal human cells (fibroblasts and amniotic cells) and human cancer cells (Hela strain), together with cultures of lysogenic bacteria (E. coli K-12), have been consistently used as radiation indicators on Soviet spacecraft. Results of these

experiments show that repeated exposure of a culture of Hela cells to spaceflight factors on the Vostok-4 and Vostok-6 flights produced changes in experimental cells as compared with laboratory controls and with Hela cells exposed on one spaceflight only. A longer latent period of recovery of growth capacity and other characteristics were noted in twice-flown cultures. In addition, the coefficient of proliferation for Hela cells exposed on both Vostok-4 and Vostok-6 was one-half that for intact controls and for Hela cells exposed to spaceflight only once. These data suggest that spaceflight factors have a direct dependence of biological effect on length of spaceflight exposure has not been established in experiments with the other radiation indicator, the lysogenic bacteria E. coli K-12. It is interesting to note that when the same Hela cells used on Vostok-4 and Vostok-6 were also exposed on Voskhod-1, a well-defined drop in the proliferation coefficient was observed in comparison with intact cultures. Other reliable differences were also found between intact controls and thrice-exposed cultures. However, no reliable differences could be detected between thrice-exposed Hela cells and a control strain used only on Vostok-6. It is suggested that the biological effect of spaceflight may be the result of the combined influence of radiation, vibration, and weightlessness. TAB

N68-16938# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.

EFFECTS OF MICROWAVE RADIATION ON THE EYE

L. Birenbaum, I. Kaplan, S. W. Rosenthal, H. Schmidt, and M. M. Zaret *In its* Microwave Res. Inst. Programs Nov. 1967 (See N68-16927 07-10) p 50–53 refs

(Contract DA-MD-49-193-65-6142)

The effects of exposure to 70 GHz microwave power on the eyes of rabbits were studied by observing the cataractogenic threshold curves for pulsed and continuous wave power. Tentative results established a power level of 610 milliwatts for 30 minutes as sufficient to cause the development of corneal opacities and, in one case, the initiation of corneal vascularization. G.G.

N68-17039 Federal Aviation Administration, Oklahoma City, Okla. Office of Aviation Medicine.

EVALUATION OF A BIOCIDAL TURBINE-FUEL ADDITIVE

Charles R. Crane and Donald C. Sanders Aug. 1967 10 p refs

(AM-67-21) CFSTI: HC$3.00/MF$0.65

Growth of microorganisms in water-contaminated, kerosene-type fuels is a widespread problem in aviation. One approach to the solution of this problem is the introduction into fuel of a chemical additive which could stop or retard growth of microbes. Evaluation of the effectiveness of such an additive was conducted in the laboratory under conditions which approximated field operations. Organisms of known identity and isolates from contaminated fuel, when cultured in aqueous nutrient media, responded variably to the additive; however, most fungi and bacteria were severely inhibited by 1,000–5,000 ppm. In simulated fuel cells containing turbine fuel and an aqueous solution of inorganic salts, all fungi were killed within four days at 270 ppm additive. Tests also showed that while microbes remain viable in dry fuel, they require a discrete water phase for multiplication. Author

N68-17046# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.

CHARACTERISTICS OF BREATHING APPARATUS USED IN HEALTH PHYSICS [CARACTERISTIQUES DE L'APPAREIL RESPIRATOIRE UTILISABLES EN RADIOPROTECTION]

Francois Perissin-Pirasset Jun. 1967 66 p refs In FRENCH

(CEA-R-3234)

The present state of knowledge makes it possible to envisage the calculation of doses absorbed by various parts of the respiration apparatus following inhalation of radioactive dusts contained in aerosols. After recalling certain anatomical and histological considerations, various curves showing the deposition of dusts in the three parts of the breathing apparatus are presented including the nasopharynx, the trachea and windpipe, and the pulmonary parenchyma. The dusts can be classified in three groups of biological solubility according to the rates of elimination of the particles from the organs. A synthesis of these data is given in elimination diagrams. In order to calculate the doses it is necessary furthermore to know certain anatomical and physiological characteristics of a standard man. Author (NSA)

N68-17086*# State Univ. of New York at Buffalo. Center for Theoretical Biology.

[MULTIDISCIPLINARY RESEARCH IN THEORETICAL BIOLOGY] Annual Report, Jan.–Dec. 31, 1967

James F. Danielli 31 Dec. 1967 134 p

(Grant NGR-33-015-016)

(NASA-CR-93002) CFSTI: HC$3.00/MF$0.65 CSCL 06C

The Center for Theoretical Biology and its organization are briefly described, and the activities of the center and its members are outlined. Summarized reports are presented in the following fields of research: Quantum biochemistry, macromolecules, biophysical systems, monomolecular film studies, membranes, receptors, cell physiology, and the central nervous system and sensory communication. N.E.N.

N68-17112*# National Aeronautics and Space Administration, Washington, D. C.

CHANGES IN INDICES OF EXTERNAL RESPIRATION, GAS EXCHANGE AND ENERGY EXPENDITURES IN WEIGHTLESSNESS

I. I. Kas'yan, G. F. Makarov, and B. V. Blinov Dec. 1967 10 p refs Transl. into ENGLISH of the book "Izmeneniye Pokazateley Vneshnego Dykhaniya, Gazoobmena i Energotrat v Usloviyakh Nevesomosti" (USSR) p 1–12 Presented at 18th Congr. of the Intern. Astron. Federation, Belgrade, 25–30 Sep. 1967

(NASA-TT-11406) CFSTI: HC$3.00/MF$0.65 CSCL 06P

Data are presented on the functional state of external respiration, gas metabolism, and energetic expenditures of man during brief weightlessness simulated by parabolic flight in a laboratory aircraft. Experiments were made on a total of 58 flights with participation of 55 subjects ranging in age from 22 to 46 years. The following data were recorded: respiration rate, vital capacity of the lungs, pulmonary ventilation, and exhaled air samples. C.T.C.

N68-17116*# Midwest Research Inst., Kansas City, Mo.

MEDICAL APPLICATIONS OF AEROSPACE SCIENCE AND TECHNOLOGY Quarterly Report, Nov. 1, 1967–Jan. 31, 1968

David Bendersky 31 Jan. 1968 63 p refs

(Contract NASr-63(13); MRI Proj. 3077-E)

(NASA-CR-92977; QR-3) CFSTI: HC $3.00/MF $0.65 CSCL 06S

Efforts to transfer applicable science and technology from the space program to the nonaerospace medical field are described. Special medical problems are defined by the research staffs at participating medical and bioengineering schools, and the results are presented of literature searches and contacts with NASA centers and contractors to identify the aerospace-generated technology which offers potential solutions to these problems. Brief technical data are presented on a lamp for measuring oxygen concentration in water vapor; nondestructive testing of bone; an EEG telemetry helmet; a temperature telemetry system; an automated microsyringe; subminiature biotelemetry unit for remote physiological investigations; graphic blood pressure measuring system; digital computer processing of X-ray photos. Also included are technology transfer reports on actual and potential transfers including

electrocardiogram electrodes, muscle accelerometer, respirometer helmet, impedance cardiograph, electroencephalogram helmet, sterile operating rooms, bone elasticity measurement, eyelid closure measurement, and a system for delivering medication to the respiratory tract. M.G.J.

N68-17144# Advisory Group for Aerospace Research and Development, Paris (France).
PRINCIPLES OF BIODYNAMICS. SECTION A. PROLONGED ACCELERATION: LINEAR AND RADIAL
[1967] 87 p refs
CFSTI: HC $3.00/MF $0.65

The principles of prolonged linear and radial acceleration as related to aerospace biodynamics are presented. The four sections include acceleration terminology, an introduction to the physics and physiology of acceleration, the dynamics of rotation applied to centrifuges, and a summary of human tolerance to prolonged acceleration. R.N.A.

N68-17148*# California Univ., Berkeley. Dept. of Nutritional Sciences.
NUTRITIONAL REQUIREMENTS AND BREEDING BEHAVIOR OF *PEROGNATHUS* Semiannual Progress Report, 1 Jul.–31 Dec. 1967
Rosemarie Ostwald 31 Dec. 1967 14 p
(Grant NGR-05-003-118)
(NASA-CR-92980) CFSTI: HC $3.00/MF $0.65 CSCL 06C

The adequacy of a semi-purified diet was tested. Organ weights, carcass composition, serum electrolytes and organ histology was found to be the same in groups of *P.Pe.* fed a semi-synthetic diet compared to those fed their usual diet of mixed seeds. The diet was found adequate to maintain weight and normal behavior in a group of Kangaroo rats, another species of desert rodents that do not require water. Laboratory-bred *P.Pe.* required supplementation with moisture containing foods of both the seed and the semi-purified diet for adequate growth. Study of the hematology of *P.Pe.* fed the semi-purified diet suggested that this diet may not be fully adequate to maintain normal hematopoiesis. Protein and amino acid requirements of *P.Pe.* were studied. A relatively narrow range of 20–25% was found to be required for soy protein in the semi-purified diet. Breeding behavior was further studied. Author

N68-17156*# National Aeronautics and Space Administration, Washington, D. C.
SPACECRAFT ENVIRONMENT AND TOLERANCE TO HYPOXIA
N. A. Agadzhanyan, I. N. Zakharova, L. V. Kalyuzhnyy, and A. V. Sergiyenko Dec. 1967 12 p Transl. into ENGLISH of the book "Usloviya Obitaniya v Germokabinakh, Perenosimost' Gipoksii" (USSR) Presented at the 8th Congr. of the Intern. Astron. Federation, Belgrade, 25–30 Sep. 1967
(NASA-TT-F-11405) CFSTI: HC $3.00/MF $0.65 CSCL 06S

Experiments are described in which the EEG were studied on rabbits under conditions of hypoxia. Biopotentials were recorded from the visual region of the cortex of the lateral field of hypothalamus, dorsal hippocampus, and reticular formation of the midbrain. A conditioned alimentary reflex was produced in each animal, and the animals were subjected to increases in altitude. It was noted that at 3,000 m, there is an alleviation of the conditioned reflexes, and at an altitude of 6,000 m, the alimentary reflexes disappear but the defense reflexes remain. A quantitative evaluation of the EEG changes indicates that at a rate of 25 m/sec there is a reliable decrease of the delta wave energy. It was concluded that gradual acclimatization increases tolerance to high altitudes, and that tolerance depends on environmental conditions, time of day, and seasonal changes. N.E.N.

05 BIOTECHNOLOGY

Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N68-16183*# Weber Aircraft Corp., Burbank, Calif.
THE DEVELOPMENT OF A UNI-DIRECTIONAL LIGHT-WEIGHT ENERGY ABSORBING NET COUCH-RESTRAINT SYSTEM FOR USE IN THE APOLLO OR FOLLOW-ON PROJECTS Final Report, Oct. 1964–Aug. 1966
David L. Hohansen 19 Aug. 1966 185 p refs
(Contract NAS9-3497)
(NASA-CR-65941; DR-5893) CFSTI: HC $3.00/MF $0.65 CSCL 05E

This report summarizes the technical tasks performed during this period in the design, development, testing and fabrication of a prototype system which would be interchangeable with the existing hard couch system in the Apollo spacecraft. The program was divided into two phases identified as a development phase and a fabrication phase. The development phase was proportioned to take advantage of the state-of-the-art techniques in the fibre and fabric processing industry. These techniques were utilized to develop a body support insert concept which would attenuate a 50-g impact force to 20-g as felt by an anthropomorphic dummy. Three fabrication techniques, each prepared by a different supplier, were analyzed and evaluation tests performed. As a result the twisted cord filament wound construction concept, utilizing undrawn nylon fibers, was selected for the prototype couch system. Phase II—Fabrication and Test of the Couch System—was provided first, to incorporate modifications resulting from the Phase I tests; second, to perform additional tests; and third, to design and fabricate a three man couch system capable of being installed in the Apollo Command Module. Author

N68-16237*# Department of the Army, Fort Detrick, Md.
EVALUATION OF TWO NASA BIOLOGICAL ISOLATION GARMENTS
H. Gerald Guyton and Charles E. Mick 29 Dec. 1967 11 p refs *Its* Protect. Branch Rept. of Test No. 3–68
(NASA-CR-92809) CFSTI: HC $3.00/MF $0.65 CSCL 06Q

Two Biological Isolation Garments (BIG) were evaluated using aerosols of *B. subtilis* var *niger* spores. This garment is one-piece suit fabricated from permeable cloth and contains a zippered closure extending diagonally from the crotch across the left chest and curving over the left ear to the top of the head. A protective mask with a full-width visor is enclosed within the suit except for dual aerosol canisters which can be attached or detached from the exterior. A one-piece suit of cotton underwear is worn under the garment. The BIG will be donned by a returning lunar astronaut immediately after his exit from the space capsule in order to isolate him and thereby restrain any lunar microorganisms on his body from contaminating the earth's atmosphere. Design specifications for the BIG require a minimum restraining capability of 98% of particles having a diameter of 0.45μ. Two test methods were employed to evaluate the BIG. Author

N68-16241# Applied Psychological Services, Wayne, Pa.
DIGITAL SIMULATION OF CREW PERFORMANCE. VALIDATION OF A DIGITAL SIMULATION MODEL FOR CREW PERFORMANCE SIMULATION
Arthur I. Siegel, J. Jay Wolf, and Richard S. Lanterman Sep. 1967 59 p refs
(Contract N00014-66-C-0280)
(PRR-2-68; AD-663291)

The validation and utilization of a psychosocially-oriented digital simulation model is described. A realistic 21-day mission is presented, followed by the results of the application of the stochastic, mathematical model to this mission. The accuracy and reasonableness with which the predictive technique corresponded with actual performance data are shown for variables such as crew size and composition, work loads, crew efficiency, morale, proficiency, and task failures. The internal coherency of certain predictions is discussed and the applicability of the technique supported. Author (TAB)

N68-16353*# Lockheed Missiles and Space Co., Sunnyvale, Calif. Biotechnology Organization.

EVALUATION TESTING OF ZERO GRAVITY HUMIDITY CONTROL SYSTEM

Thomas M. Olcott and Richard A. Lamparter 25 Oct. 1967 110 p

(Contract NAS1-5622)

(NASA-CR-66543) CFSTI: HC $3.00/MF $0.65 CSCL 05E

This report describes a test and evaluation program to demonstrate the feasibility and establish optimum design criteria for a humidity control system with a hydrophobic/hydrophilic cone zero gravity water separator. The test program demonstrated water separator performance at 40, 70 and 100 CFM at inlet humidities up to 0.191 lbs H_2O/lb. air and a water removal rates up to 0.012 lbs. H_2O/lb. air. The report defines the methodology and provides the reduced test program data to establish optimum design/performance criteria for zero gravity humidity control systems utilizing a hydrophobic/hydrophilic cone water separator. Author

N68-16397# Applied Psychological Services, Wayne, Pa. Science Center.

RECENT REVISIONS TO THE DIGITAL SIMULATION MODEL FOR SIMULATING TWO-OPERATOR MAN-MACHINE INTERACTION

Arthur I. Siegel and J. Jay Wolf Nov. 1967 53 p refs

(Contract N00014-66-C0184)

(AD-663158)

The logic and application of a previously developed digital computer model for simulating the actions of one or two operators as they interact within a hardware system in order to achieve the goals of a mission are described. Then, the logic is expanded to include an operator level of aspiration variable. A number of other recent modifications to the model are also pointed out. The results of computer runs employing the level of aspiration variable are compared with runs in which the variable is not involved. Author (TAB)

N68-16577# Litton Systems, Inc., Woodland Hills, Calif. Guidance and Control Systems Div.

INTEGRATED COCKPIT RESEARCH PROGRAM, VOLUME 1 Final Report

John V. Murphy, Donald J. Pizzicara, James J. Belcher, Robert L. Hamson, and Raymond E. Bernberg Jan. 1967 148 p refs

(Contract Nonr-4951(00))

(AD-662185)

The program was designed to develop a methodology for avionic system design application to aircraft in an advanced time period. Emphasis was placed on two major activities. One was concerned with identifying the requirements for the operator/avionic system in the future time period, and a second activity was concerned with identifying the technological state-of-the-art that would be available in the advanced time period to meet those requirements. Successive aspects of the study were concerned with synthesizing an avionic system, completing a cost/effectiveness evaluation, and the preparation of a cockpit mockup. Volume I describes a 27-step process that can be applied to any aircraft system early in the developmental cycle. Author (TAB)

N68-16594*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

EVALUATION OF A CLOSED-CIRCUIT TELEVISION DISPLAY IN LANDING OPERATIONS WITH A HELICOPTER

William Gracey, Robert W. Sommer, and Don F. Tibbs Washington Feb. 1968 20 p refs

(NASA-TN-D-4313) CFSTI: HC $3.00/MF $0.65 CSCL 05H

An instrument display consisting of a television monitor; vertical-type torquemeter was evaluated in simulated IFR (Instrument Flight Rules) approaches with a helicopter. The evaluation was made with three lenses having focal lengths of 12.5, 25, and 50 mm. The restricted-view tests with binocular vision showed that a view as small as 22.6° horizontal and 18.5° vertical has a detrimental effect on the control of longitudinal position at touchdown. The tests with monocular vision showed that the control difficulties increase with the loss of depth perception. The tests of the television display showed that the difficulties in controlling attitude and position increased as the helicopter approached the ground. The determination of position and position-rate information was made difficult because of the restricted views of the lenses, the image magnification and the low resolution and lack of depth perception of the televised scene. The tests demonstrated that, with the television display augmented by height information, the pilots were able to execute low-speed, steep approaches with an angular view as small as 22.6° by 18.5° and an image magnification as small as about 0.35. Author

N68-16626*# Weber Aircraft Corp., Burbank, Calif.

UNIDIRECTIONAL LIGHTWEIGHT ENERGY ABSORBING NET COUCH RESTRAINT SYSTEM FOR USE IN APOLLO OR FOLLOW-ON PROJECTS, PHASE 1 AND 2 Final Material Report

David L. Johansen Sep. 1966 57 p ref

(Contract NAS9-3497)

(NASA-CR-65939; DR-5895) CFSTI: HC $3.00/MF $0.65 CSCL 05E

Three different body support concepts were fabricated. Each was statically and dynamically tested on a boilerplate couch structure and evaluated on its ability to satisfy the requirements of the program. The scope of these requirements included couch occupant comfort and weight distribution, articulation capability and system response characteristics to spacecraft launch, and landing impact load conditions. In the course of developing these systems, tests were performed on selected synthetic fibers which appeared to posses the required high impact plastic hysteretic characteristics. The materials selected for test were partially drawn nylon yarn, fully drawn nylon yarns, formic acid and treated nylon yarns, and heat shrunk dacron yarns. This book summarizes the data collected during the experiments performed on various material samples and indicates the results of each phase of the test performed. C.T.C.

N68-16641*# National Aeronautics and Space Administration, Washington, D. C.

BIOENGINEERING PROBLEMS OF HABITABILITY OF SPACE CRAFT AND PLANETARY STATIONS [BIOLOGO-TEKHNICHESKIYE VOPROSY OBITAYEMOSTI KOSMICHES-KIKH KORABLEY I PLANETNYKH STANTSIY]

B. A. Adamovich and Yu. G. Nefedov Dec. 1967 5 p refs Transl. into ENGLISH from Russian Presented at the 18th Congr. of the Intern. Astronautical Federation, Belgrade, 25–30 Sep. 1967

(NASA-TT-11398) CFSTI: HC $3.00/MF $0.65 CSCL 05E

Safety conditions, favorable cabin environments, and overall life support systems are among the bioengineering problems related to maintaining life aboard spacecraft and planetary stations. Oxygen supply, water, and nutrients for astronauts are considered; and emphasis is placed on the need for considerable experimentation before the actual life support system can be selected. M.W.R.

N68-16676# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE PNEUMOCARDIOPHONE [PNEVMOKARDIOFON]
R. M. Bayevskiy, V. A. Ivanov, A. V. Monakhov, and A. V. Monakhov 28 Jul. 1967 11 p refs Transl. into ENGLISH from Fiziol. Zh. SSSR (Moscow), v. 52, no. 10, 1966 p 1273–1275
(FTD-HT-67-484; AD-662800)

A simple system for continuously monitoring pulse and respiration rates over long periods of time is described. A record can be made with any single-channel recorder: The output can also be connected with an amplifier-speaker system or displayed on an oscillograph. Signals from a respiration sensor in which make-and-break is accomplished by expansion and contraction of the rib cage, and cardiac biocurrents, are used as input signals. Silver electrodes 18–20 mm in diameter are held over the fifth intercostal space along the medial axillary line by an elastic harness to which the respiration sensor is also attached. The basic idea of the system is the single-channel recording of two parameters. This is done by shaping cardiac biopotentials corresponding to the R rhythm into square pulses whose duration or amplitude is determined by the respiration sensor. Respiration signals are thus read from the duration or amplitude of the pulse signals. In the pulse duration modulation setup, the R-wave peak is formed into a square pulse lasting 100–150 msec during exhalation (contact closed) and 200–300 msec during inhalation (contact open). These pulses can also be used to generate an acoustic signal. TAB

N68-16677# Bolt, Beranek, and Newman, Inc., Van Nuys, Calif.
GROWTH OF NOISINESS FOR TONES AND BANDS OF NOISE AT DIFFERENT FREQUENCIES
John E. Parnell, David C. Nagel, and Hugh J. Parry Dec. 1967 91 p refs
(Contract FA-65-WA-1180)
(FAA-DS-67-21) CFSTI: HC $3.00/MF $0.65

Judgment tests have been conducted to measure the growth of noisiness for tones and narrow bands of noise under various listening conditions. The growth of noisiness for a 1 kHz tone and an octave band of noise centered at 1 kHz were measured using both the method of adjustment and a magnitude estimation method. Equal noisiness contours were determined for selected listening conditions in order to measure the growth of noisiness at frequencies other than 1 kHz. The growth of noisiness was found to depend strongly on test method with the magnitude estimation tests giving significantly larger values for doubling or halving of perceived noisiness. Equal noisiness contours are shown for pure tones in a free field, one-third octave bands of noise in a free field and one-third octave bands of noise in a diffuse field. Also, comparisons of equal noise contours for one-second and four-second stimulus durations and for loudness and noisiness instructions are given. No significant differences were found for these comparisons. Further, it was concluded that the specific value used for the growth of noisiness did not significantly affect the calculation of the relative PNL values for many different spectra. Author

N68-16799# Federal Aviation Agency, Oklahoma City, Okla. Dept. of Transportation.
ADAPTATION TO VESTIBULAR DISORIENTATION. 8: "CORIOLIS" VESTIBULAR STIMULATION AND THE INFLUENCE OF DIFFERENT VISUAL SURROUNDS
William E. Collins Aug. 1967 15 p refs
(AM-67-19)

The direction, extent and intensity of the illusions produced by Coriolis vestibular stimulation were investigated with subjects (a) in total darkness, (b) viewing simulated wing-tip lights and a rotating beacon in an otherwise totally dark room, and (c) viewing the simulated aircraft lights through a window in a luminous "cabin" in an otherwise totally dark room. During 72°/sec rotation about the yaw-axis, lateral head movements of 30° produced mean verbal estimates of apparent "diving" and "climbing" sensations between 33.8°–87.2°. Intensity ratings of the sensation of apparent displacement were greatest for the simulated aircraft lights condition, and the relative intensity of sensation between one type of head movement as compared with another appeared to be affected by the visual surrounds. Author

N68-16818# Lockheed Missiles and Space Co., Sunnyvale, Calif.
WEIGHTLESS SIMULATION USING WATER IMMERSION TECHNIQUES: AN ANNOTATED BIBLIOGRAPHY
J. H. Duddy, comp., O. T. Kallos, comp., V. D. Caswell, comp., and A. T. Vogt, comp. Dec. 1967 112 p refs Rean-Revised
(LMSC-5-24-65-3, Rev. 2)

This compilation contains 215 selected references pertaining to behavioral and biomedical research involving human subjects. The references are organized under three topics: (1) physiological studies, including acceleration stress tolerance and physiological responses to simulated weightlessness, (2) human engineering studies of man's performance capabilities under neutral buoyancy conditions simulating weightlessness, and (3) techniques and personal equipment requirements for weater immersion studies. The references are arranged alphabetically by author, or by title if appropriate, under each of the three topics. An author index is included as an aid in locating the contributions of specific investigators. The references cited were drawn from the literature published or privately distributed during the period from January 1951 through December 1967. Author

N68-16896*# Honeywell, Inc., Minneapolis, Minn. Systems and Research Div.
RESEARCH ON COMPUTATIONAL AND DISPLAY REQUIREMENTS FOR HUMAN CONTROL OF SPACE VEHICLE BOOSTERS. PART 1: THEORY AND RESULTS Final Report, 22 Jun.–22 Oct. 1966
J. D. Gilchrist and R. Livingston Nov. 1966 120 p refs
(Contract NAS8-20023)
(NASA-CR-61554; Rept.-12513-FR2, Pt. 1) CFSTI: HC $3.00/MF $0.65 CSCL 05H

The theory, experimental results, and conclusions are presented of a study of man–computer near-optimal guidance and control techniques. The Reusable Orbital Transport, a two-stage launch vehicle with appreciable aerodynamic lift capability in the first stage, was used, and a comparative evaluation for onboard application of near-optimal trajectory prediction techniques was made. The Predictive Model Guidance Scheme (PMGS) and the Nominal Guidance Scheme (NGS) were simulated on a real-time basis with a pilot actively engaged in the guidance function. The PMGS was simulated for the second stage only, and NGS was studied for purposes of comparison. It was concluded that the PMGS is more accurate, flexible, and fuel-optimal, and has a lower pilot work load, and that the NGS has lower computer and display requirements. N.E.N.

N68-16911*# National Aeronautics and Space Administration, Washington, D. C.
INVESTIGATION OF VISUAL WORK CAPACITY IN SPACE FLIGHT [ISSLEDOVANIYEYRITEL'NOY RABOTOSPOSOBNOSTI I KOSMICHESKOM POLETE]
Ye. A. Ivanov, V. A. Popov, and L. S. Khachaturyants Jan. 1968 7 p Transl. into ENGLISH from Russian Presented at the 18th Congr. of the Intern. Astronautical Federation, Belgrade 25–30 Sep. 1967
(NASA-TT-F-11404) CFSTI: HC $3.00/MF $0.65 CSCL 05E

Experiments and investigations are briefly discussed which were conducted prior to actual space flight to determine the effects of the space environment, especially weightlessness, on the functions of vision. A detailed description is given of tests and test methods used onboard the Voskhod spacecraft to determine the sharpness of vision, visual work capacity, and perception of colors of astronauts. Evidence shows that the sharpness of vision during

an orbital flight is higher than average standards, but this only pertains to objects that extend linearly. The visual work capacity is considerably reduced during space flight due to the fact that weightlessness disrupts not only the overall coordination of motion but also the coordination of the group of eyeball moving muscles. A large reduction in the subjective brightness of colors observed by the astronauts was noted; however, this phenomenon is still unexplainable. R.N.A.

N68-16974# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.

A PROBE TO MONITOR ELECTROANESTHESIA CURRENT DENSITY

S. Deutsch *In its* Microwave Res. Inst. Programs Nov. 1967 p 173–175 (See N68-16927 07-10)
(Grant NSF GU-1557)

Details are given, and drawings are shown for an electronic probe that monitors electroanesthesia current density while inserted into the brain of an animal or human patient. The probe measures magnitude and direction of currents forced through the brain via generator electrodes with the help of a balancing potentiometer. G.G.

N68-17038# Federal Aviation Administration, Oklahoma City, Okla. Office of Aviation Medicine.

REACTION TIME AS A FUNCTION OF FLASH LUMINANCE AND DURATION

Mark F. Lewis and Henry W. Mertens Nov. 1967 9 p refs
(AM-67-24) CFSTI: HC $3.00/MF $0.65

As a consequence of the high speeds of modern aircraft, pilots must respond quickly to signal lights from the ground or other aircraft during night flight. The present study was concerned with the relation of reaction time to flash luminance and duration. Reaction time was a decreasing, negatively accelerated function of flash luminance. Flash duration had no clear effect upon reaction time. Author

N68-17066# Federal Aviation Agency, Oklahoma City, Okla. Dept. of Transportation.

PERCEIVED DEPTH BETWEEN FAMILIAR OBJECTS

Walter C. Gogel and Henry W. Mertens Aug. 1967 7 p refs
(AM-67-20)

The hypothesis was examined that the essential factor in the size cue to depth from familiar objects is the perceived size S'' per unit of retinal size θ of each of the objects, with the object having the largest value of S''/θ appearing to be the more distant object. Five familiar objects were simulated. The objects were presented in pairs and the Os indicated their perceived width (S'), the perceived distance (D') of each from himself, and the perceived depth (d') between the objects in each pair. In agreement with the above hypothesis, the results indicate that the perceived depth between the objects was a monotonic function of the difference between the values of S''/θ. The average values of d' and D' were similar to the simulated values for distance up to approximately three feet from the observer. For greater distances the error in the average d' and D' values increased with an increase in the simulated distances. The results support the notion that the familiar size cue to depth can occur between objects of dissimilar shape whenever those objects have perceived sizes. Author

N68-17067 Douglas Aircraft Co., Inc., Santa Monica, Calif. Nuclear Technology and Subsystems Branch.

POPULATION EXPOSURE PROBABILITY MODEL FOR RANDOM RE-ENTRY OF A NUCLEAR SATELLITE

C. R. Easton, R. W. Langley, and G. H. Anno Sep. 1967 19 p refs
(Douglas Paper-4736; Rept.-1599-1-DP204)

A satellite carrying radioactive material in a near-Earth orbit has a finite probability of re-entering before the radioactivity has decayed to a harmless level. If the re-entry is unplanned, it is normally impossible to predict the impact point to a useful degree of accuracy. This paper deals with such cases. The probability distribution function for latitude of impact is derived for a general case. This function is then combined with an injury probability model and a population distribution model to compute probabilities of injury. The results are correlated as the dependence of probability of injury on latitude and orbital inclination angle. It is shown that probability of injury peaks for an orbital inclination of 30° to 60°. Author

N68-17130# Royal Aircraft Establishment, Farnborough (England).

A NEW TONOMETER FOR EQUILIBRATING BLOOD WITH DIFFERENT GAS PRESSURES QUICKLY [EIN NEUES TONOMETER ZUR RASCHEN AQUILIBRIERUNG VON BLUT MIT VERSCHIEDENEN GASDRUCKEN]

Detlef Laus Oct. 1967 6 p refs Transl. into ENGLISH from Arch. Ges. Physiol. (Berlin), v. 254, no. 2, 1951 p 142–143
(RAE-LIB-TRANS-1255) CFSTI: HC $3.00/MF $0.65

A new type of tonometer is described for equilibrating 4 cm^3 of blood with physiological gases within 10 minutes. Author

N68-17162*# LTV Aerospace Corp., Dallas, Tex. Astronautics Div.

UNMANNED THERMAL PERFORMANCE EVALUATION OF A GEMINI EXTRAVEHICULAR SPACE SUIT. VOLUME 1: TEST REPORT GEMINI BRAVO TEST SERIES SPACE ENVIRONMENT SIMULATOR TEST

R. J. Copeland, E. G. Lipnicky, and F. H. Goodnight 15 Jul. 1965 364 p ref
(Contract NAS9-3414)
(NASA-CR-65935; Rept.-00.683, V. 1) CFSTI: HC $3.00/MF $0.65 CSCL 06K

The Gemini suit tested was a G-2C suit modified to the configuration of the extravehicular suit (integrated thermal and micrometeoroid protective materials). The helmet was uninsulated and fitted with a sunshade which lowers over the helmet visor. The visor was coated on the exterior surface with a low emittance coating to help maintain the visor above fogging temperatures. Suit insulation extends to the soles of the boots and insulated gloves were provided. The 25-foot Gemini extravehicular umbilical which supplies oxygen, power, and communication lines was used during simulated orbits. The suit was worn by a 15th percentile size thermal dummy throughout the tests. The tests were performed in a 10-foot diameter horizontal test chamber capable of simulating the vacuum and thermal environments of space. Author

N68-17171*# LTV Aerospace Corp., Dallas, Tex. Astronautics Div.

SPACE ENVIRONMENT SIMULATOR TEST PROGRAM. VOLUME 2: UNMANNED THERMAL PERFORMANCE EVALUATION OF A GEMINI EXTRAVEHICULAR SPACE SUIT Test Report, May 1965

R. J. Copeland, E. G. Lipnicky, and F. H. Goodnight 15 Jul. 1965 704 p
(Contract NAS9-3414)
(NASA-CR-65936; Rept.-00.683, V. 2) CFSTI: HC $3.00/MF $0.65 CSCL 06K

Plots of temperature data measured during the Gemini Bravo series of space suit tests are presented. The tests were designed to experimentally evaluate the thermal performance and design adequacy of the extravehicular suit for operations in space. Also evaluated was the comfort of the suit inside a spacecraft with the hatches open. Two prototype suits were subjected to a series of simulated space environmental extremes and to simulated actual orbits. Included are evaluations of the effects of suit contact with spacecraft surfaces and the effects of different visor configurations. C.T.C.

N68-17173*# Weber Aircraft Corp., Burbank, Calif.
APOLLO STOWABLE NET COUCH, PHASE 3 Final Report
W. E. Cooper 9 Mar. 1967 74 p
(Contract NAS9-3497)
(NASA-CR-65940; DR-5935) CFSTI: HC $3.00/MF $0.65 CSCL 05E

The three-man stowable couch configurations, the functional design, and the stress analysis are summarized. The couch articulation, restraints, and suspension structure are briefly described along with the disassembly and stowage. The most critical structural areas in the system are considered to be the intersection of the Y–Y beam to the stabilizer beam and the couch hip joint. Actual mock-ups of the disassembly are reviewed, and the essentials of a development and qualification program are outlined. Drawings of the couch, and discussions of the loads, stress, and weight analyses, and operating procedures are included. N.E.N.

N68-17175*# General Electric Co., King of Prussia, Pa.
REGENERABLE ADSORBENT STUDY
Larry C. Spece, F. P. Rudek, T. F. Green, and R. A. Miller [1967] 123 p refs
(Contract NAS1-6574)
(NASA-CR-66529) CFSTI: HC $3.00/MF $0.65 CSCL 06K

Details are given on the performance of a thin film solid regenerable adsorbent, e.g. (determine CO_2 adsorption rates, efficiencies, sizing criteria, and other pertinent system design parameters). The investigations were carried out for a range of environmental conditions which covered the normal operating levels for a typical flight system. The tests were organized into three and four variable factorial designs, and the data were treated by standard statistical techniques. This type sorber panel is most appropriate for coadsorption of H_2O and CO_2, or for use with a conventional predryer in which CO_2 is desorbed to space. The limitng resistance to CO_2 adsorption is evidently the boundary gas film at the surface of the sieve panel and not within the sieve itself. Equilibrium capacity was nearly 25 percent less than that reported by the manufacturer for pellet beds. A simplified model was formulated and verified experimentally for the thin film sorber plate. A system weight was derived with this model and the test results which compared favorably with packed bed-type systems. Development of panels with more efficient heat transfer characteristics is possible, and should be completed before a prototype system design is undertaken. Author

N68-17179*# General Dynamics/Convair, San Diego, Calif.
STUDY OF ZERO GRAVITY CAPABILITIES OF LIFE SUPPORT SYSTEM COMPONENTS AND PROCESSES Final Technical Report, Dec. 28, 1966–Dec. 28, 1967
16 Feb. 1968 167 p refs
(Contract NAS1-6939)
(NASA-CR-66534; GDC-DBD67-004) CFSTI: HC $3.00/MF $0.65 CSCL 06K

A study was conducted to define a program of determining the zero gravity capabilities of the life support components and processes contained in the Integrated Life Support System (ILSS). The study included the identification, and evaluation of gravity-sensitivities inherent in the ILSS components and processes; the investigation of methods for experimentally evaluating those critical items for which zero-gravity performance could not be adequately determined by analytical techniques; and the formulation of criteria for assessing the gravity-sensitivity of alternate life support system processes. It was concluded that greatest benefit could be realized from experimentation to validate and support the analytical problem areas of heat transfer and liquid transport. Testing of the ILSS processes of liquid-mixing and flame propagation was felt to be of less value as future life support system designs are expected to appreciably reduce or eliminate the importance of their gravity-sensitivities. A particularly pertinent conclusion is that the majority of processes in the ILSS are of such a nature that their gravity sensitivities can be satisfactorily assessed by analyses; reducing the need for special component testing. Author

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N68-16126# California Univ., Berkeley. Lawrence Radiation Lab.
SIMULTANEOUS DETERMINATION OF ^{18}O AND ^{16}O ISOTOPES BY ^{3}He ACTIVATION ANALYSIS
James F. Lamb, Diana M. Lee, and Samuel S. Markowitz Oct. 1967 11 p refs Presented at Activation Anal. with Charged Particles Conf., Liege, 21 Sep. 1967
(Contract W-7405-ENG-48)
(UCRL-17812; CONF-670947-2) CFSTI: HC $3.00/MF $0.65

From 2nd International Meeting on Practical Aspects of the isotopic content of oxygen in various materials may be determined by nuclear reactions induced in oxygen during bombardment by $^{3}He^{2+}$ ions accelerated to about 10 MeV. The reactions of interest are: $^{16}O(^{3}He,p)^{18}F + ^{16}O(^{3}He,n) = {}^{18}Ne \rightarrow {}^{18}F$ and $^{18}O(^{3}He,p)^{20}F$. The accuracy and sensitivity are both concerned primarily with counting statistics which, in turn, are governed by available beam current. NSA

N68-16127# Northwestern Univ., Evanston, Ill. Dept. of Chemistry.
PHYSICAL CHEMISTRY OF HIGHLY ENERGETIC SYSTEMS Technical Progress Report, Feb. 1967–Feb. 1968
F. E. Stafford 30 Oct. 1967 3 p
(Contract AT(11-1)-1147)
(COO-1147-22) CFSTI: HC $3.00/MF $0.65

Developments are reported for studies on: absolute ionization cross section of Ag; relative cross sections of transition elements; and reactions of hydrogen with boron and/or carbon at 2000°C. NSA

N68-16129# Pennsylvania Univ., Philadelphia. Dept. of Chemistry.
[DEUTERIUM SEPARATION] Progress Report, 1 Jan.–1 Oct. 1967
David White 1 Oct. 1967 13 p
(Contract AT(30-1)-3783)
(NYO-3783-3) CFSTI: HC $3.00/MF $0.65

A scheme was considered to improve the efficiency of orthopara separations. This consisted of utilizing a single long column that is initially equilibrated with normal hydrogen or deuterium at liquid hydrogen temperatures. One end of the column is then shut off and the hydrogen or deuterium is then progressively desorbed from the closed end to the open end. For column diameters of approximately one inch and lengths of the order of 3 feet it is possible to achieve approximately 20 theoretical plates for 2 to 3 liters. The measured values of the integral ortho-para separation factor of deuterium on γ-alumina adsorbent at 20°K was 1.8 ± 0.2 whereas that for hydrogen was 3.0 ± 0.2. Cryogenic equipment required for pulsed nuclear magnetic resonance experiments was fabricated and installed. Measured vapor pressure differences between deuterium of a given para concentration and equilibrium deuterium as a function of temperature are shown. The phase transformation in solid deuterium was studied. Author (NSA)

N68-16137# Texas Nuclear Corp., Austin.
APPLICATIONS OF NEUTRON ACTIVATION TO ON-STREAM ANALYSIS
J. R. Rhodes 26 Oct. 1967 31 p refs Presented at the 8th Conf. on Radioisotopes and Exhibition of Nucl. Instr., Tokyo, 13–16 Nov. 1967
(Contract AT(40-1)-2980)
(ORO-2980-17; CONF-671112-2) CFSTI: HC$3.00/MF$0.65

Nuclear techniques for process analysis are reviewed. Some comments are made on applications of radioisotope and accelerator neutron sources, and on detection of the prompt or delayed gamma rays by spectrometric, coincidence and anticoincidence counting techniques. Different methods of sample presentation are surveyed, including semi-automatic batch sampling, covayor belt presentation of bulk materials, and continuous presentation of liquids and slurries. Applications include determination of oxygen in steel; nitrogen in food products; fluorine in fluoride minerals; aluminum in bauxite and cement; silicon in iron and a number of ores, and copper in copper ores. Author (NSA)

N68-16143# Brookhaven National Lab., Upton, N. J.
THE MECHANISMS OF OXIDATION-REDUCTION REACTIONS IN SOLUTION
Norman Sutin 21 Jun. 1967 8 p refs Sponsored by AEC *Its* Brookhaven Lecture Ser. No. 67
(BNL-50070(T-469) CFSTI: HC$3.00/MF$0.65

The mechanisms of oxidation–reduction reactions in solution are discussed in terms of electron transfer processes, in particular, how the rates of electron transfer depend upon the structures of the substances undergoing oxidation and reduction. It is shown that the oxidation–reduction reaction proceeds in a number of steps, and an attempt is made to describe the detailed arrangement of the atoms in each of these steps. Special attention is given to oxidation–reduction reactions involving metal ions. Two types of reactions are described: the first consists of reactions called outer-sphere reactions, in which no bonds are formed or broken, and the second is one in which the reaction proceeds via an inner-sphere mechanism. In these reactions a bridging group is directly bonded to both metal centers. NSA

N68-16159 Polish Academy of Sciences, Cracow. Inst. of Nuclear Physics.
RADIOTRACER STUDIES ON THE EXTRACTION AND STABILITY CONSTANTS OF SOME AROMATIC SCHIFF BASE METAL CHELATES [BADANIA EKSTRAKCJI I STALYCH TRWALOSCI CHELATOW NIEKTORYCH METALI Z AROMATYCZNYMI ZASADAMI SCHIFFA METODA WSKAZNIKOW PROMIENIOTWORCZYCH]
Ignacy Stronski 1967 78 p refs In POLISH; ENGLISH summary
(INP-573/C) CFSTI: HC$3.00/MF$0.65

A few Schiff bases, which are products of condensation of salicylaldehyde and its derivatives with 1,2-ethylene-diamine, 1,3-propylenediamine, and o-phenylenediamine, were synthesized, the dissociation constants were determined spectrophotometrically, and the stability constants of nickel and uranyl ions internal complex salts were established by means of Dyrssen and Sillen's graphic, two-parameter approximation. Using the radiotracer method, the yield of extraction (% E) of Ca(II), Mn(II), Fe(III), Ni(II), Co(II), Cu(II), Zn(II), Sr(II), Cd(II), Pr(III), Cd(III), Pb(II), and UO_2(II) ions was investigated by means of chloroform solvents of some quadridentate, aromatic Schiff bases as a function of the pH of the electrolyte. The tracer quantities of the lanthanide ions were separated from the uranyl ions. Author

N68-16172# Ludwig-Maximilians-Universitat, Munich (West Germany). Radiochemische Abteilung.
COMPARATIVE CHEMISTRY OF LANTHANIDE AND ACTINIDE ELEMENTS [FORTSCHRITTE IN DER VERGLEICHENDEN CHEMIE DER LANTHANIDEN- UND AKTINIDE-NELEMENTE] Annual Progress Report, 1966
Aug 1967 27 p refs In GERMAN; ENGLISH summary Supported by Bundesmin. fuer Wiss. Forsch.
(BMwF-FBK-67-76)

Progress in the comparative chemistry of lanthanide and actinide elements is reported under the following topics: preparation of promethium metal and approximately 30 promethium compounds; crystal chemistry of promethium and its salts; vapor–phase hydrolysis of β-$DyCl_3$, γ-$DyCl_3$, $ErCl_3$, $TmCl_3$, YCl_3, and $PmCl_3$, and determination of the heats of formation of the corresponding oxyhalides; liquidus curve of UF_5-SmF_3; lattice constants of oxalate decahydrates $Ln_2(C_2O_4)_3 \cdot 10H_2O$, where Ln = Nd, Pm, Sm, from single crystal data; attempts to measure the vapor pressure of $PaCl_5$; mixed oxide studies in the systems of UO_2 with Ho_2O_3 and Yb_2O_3; emission spectra of Np, Pu, Am, Pm; and preliminary experiments in the crystal chemistry of radium. Author (NSA)

N68-16192# California Univ., Berkeley. Lawrence Radiation Lab.
THE VISCOSITY OF CONCENTRATED SOLUTIONS OF CALCIUM IN LIQUID AMMONIA IN THE TEMPERATURE INTERVAL OF −40°C TO −70°C
Jonathan P. Earhart (M.S. Thesis) Oct. 1967 55 p refs
(Contract W-7405-ENG-48)
(UCRL-17858) CFSTI: HC$3.00/MF$0.65

The viscosity of concentrated solutions of calcium in liquid ammonia was determined in the concentration interval from 3.4 to 8.9 mole % calcium at temperatures from −40 to −70°C. The modified cross-arm viscometer used for the measurements was calibrated at each of the temperatures at which measurements were made. A minor surface tension correction was made using the surface tension of sodium-ammonia solutions in the absence of such data for calcium-ammonia solutions. An analysis of possible errors indicated that the results are accurate to ±5%. The viscosity of concentrated solutions at concentrations near the two phase region (about 40% of saturation) are nearly equal to the viscosity of pure liquid ammonia at the same temperature. At −40°C a solution with a concentration of 8.9 mole % calcium (83% of saturation) has a viscosity more than twice that of the pure solvent. Similar increases in viscosity with increasing concentration were found at all temperatures between −40 and −70°C. Author (NSA)

N68-16196 United Kingdom Atomic Energy Authority, Harwell (England). Information Branch.
OXIDE FILMS ON SILICON
V. A. Arslambekov and G. V. Smirnov Aug. 1966 15 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Neorganicheskie Mater., v. 2, no. 2, 1966 p 217–222

Some of the electrophysical properties of the surface of silicon (particularly the rate of surface recombination) are determined by the physical and chemical properties of the oxide or hydroxide films that are formed on it. The properties of these films, in their turn, are determined by the conditions of their formation. The phenomena associated with the change in weight of single crystals of silicon under the effect of illumination have been demonstrated. Author

N68-16229# Comision Nacional de Energia Atomica, Buenos Aires (Argentina).
RAPID ANALYSIS OF A MIXTURE OF SOME FISSION PRODUCTS [ANALISIS RAPIDO DE UNA MEZCLA DE ALGUNOS PRODUCTOS DE FISION]
E. Garcia Agudo 1967 19 p refs In SPANISH
(CNEA-205)

A combination method is described that can be used in any radiochemical laboratory for rapidly analyzing a mixture of fission products. The method is based on the separation by groups of several fission products, those which can be measured jointly by gamma spectrometry and those which cannot be individually separated because of their large mass and danger. In the case of having to measure ^{90}Sr-Y and ^{147}Pm, which are pure beta emitters, they are separated and measured with a Geiger tube. The

quantity of fission products contained in the sample is calculated by comparing with calibrated standards of identical geometry. With the mutichannel spectrometer, stripping techniques are applied. The appendix contains a detailed description of the stipping technique. The method is applicable to samples that contain the following fission products: ^{144}Ce–Pr, ^{147}Pm, ^{90}Sr-Y, ^{106}Ru–Rh, ^{137}Cs, and ^{95}Zr–Nb. Generally the fission products are contained in old samples in which radionuclides with short half-lives have mostly decayed. Details of the chemical separation techniques and the fission product analysis are outlined. Transl. by R.N.A.

N68-16252# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
GROWTH OF METALLIC CRYSTALS BY THERMAL DECOMPOSITION OF HALIDES IN THE GAS PHASE [CROISSANCE DES CRISTAUX METALLIQUES PAR DECOMPOSITION THERMIQUE DES HALOGENURES EN PHASE GAZEUSE]
Jacques Gillardeau Sep. 1967 24 p refs In FRENCH
(CEA-BIB-93)

Various results published on the growth of metallic crystals by the thermal decomposition of gaseous halides were obtained mainly with iodides. The experimental techniques used are described together with the various factors affecting the efficiency of metal deposition produced by this thermal decomposition. Author (NSA)

N68-16259# California Univ., Berkeley. Lawrence Radiation Lab.
AMPEROMETRIC TITRATION OF PALLADIUM (2) BY OXIDATION WITH HYPOCHLORITE
Ray G. Clem and E. H. Huffman Sep. 1967 16 p refs Presented at the 11th Conf. on Anal. Chem. in Nucl. Technol., Gatlinburg, Tenn., 10–12 Oct. 1967
(Contract W-7405-ENG-48)
(UCRL-17824; CONF-671012-3) CFSTI: HC$3.00/MF$0.65

The titration of palladium(II) by oxidation with hypochlorite to palladium(IV) is made feasible through the stabilizing influence of a 0.5 M azide supporting electrolyte at pH2 to 3 on the palladium(IV) species, resulting in a marked reduction of the oxidation potential of the Pd(IV)/Pd(II) couple. The titration end point is detected with a rotated platinum electrode at 0.5 V versus a saturated calomel electrode. The method is most useful in the range (0.5–2.1 mg Pd) slightly above that covered by spectrophotometry and below that conveniently amenable to gravimetry, with a precision of about 0.5 percent. High ratios of common metals and platinum to palladium are tolerated. Deviations from the expected 2:1 hypochlorite to palladium ratio were found while developing the procedure; these deviations are of no consequence when the titrant is standardized against palladium. Formal potential measurements of the Pd(IV)/Pd(II) couple in the recommended supporting electrolyte gave values from 0.64 to 0.53 V on changing the pH from 2 to 3, with an attendant 10-fold increase in azide ion concentration. Author (NSA)

N68-16269# IIT Research Inst., Chicago, Ill.
ENERGY TRANSFER IN POLYMETHYL METHACRYLATE
Donald Richard Ward (Ph.D. Thesis) Jun. 1967 171 p refs
(Contract AT(11-1)-1224)
(COO-1224-14) CFSTI: HC$3.00/MF$0.65

Energy transfer in polymethyl methacrylate (PMMA), containing small amounts of p-terphenyl and nonluminescent aromatic molecules or sinks, was studied by measuring the fluorescence of the irradiated samples. The samples were excited with ultraviolet radiation to produce excited electronic states and then with beta particles to generate excited electronic states and positive ions. Intermolecular energy transport was found to be more prevalent than intramolecular. Intermolecular energy transfer involves a three dimensional random walk which is suitable for analysis by a Markov chain random walk treatment. The applicability of the Markov Chain treatment to the data supports the theory that in PMMA systems the energy is localized, that the migration of excited states is a random walk process and that transfers between and from PMMA chain units do not proceed mainly via Förster's mechanism. In addition it supports the role of positive ions in energy transfer. Author (NSA)

N68-16272# Japan Atomic Energy Research Inst., Ibaraki. Takasaki Radiation Chemistry Research Establishment.
USE OF KRYPTON-85 RADIATION SOURCE FOR CHEMICAL REACTION IN LIQUID PHASE
Tomomichi Kasamatsu and Norikatsu Otsuka Dec. 1967 17 p refs Transl. into ENGLISH from Oyo Buturi (Tokyo), v. 35, no. 6, Jun. 423–429
(NSJ-TR-92) Available from Div. of Tech. Inform., Japan Atomic Energy Res. Inst.

An apparatus for chemical reaction by irradiation of materials in liquid phase with Kr-85 as the source is devised. Circulation of bubbling Kr-85 gas through the reactant facilitates the reaction. In this method, the dose rate is controlled by changing the fractional void and concentration of Kr-85 gas. When 1000 m/ of water was used as the reactant with 40% fractional void and 5% concentration of the gas, use of 200 curies of Kr-85 gave a dose rate of 2.8×10^4 rad/h at 60°C and 0.9 atm pressure. Author

N68-16311# Rocky Flats Div., Dow Chemical Co., Golden, Colo.
DETERMINATION OF CERIC OXIDE IN LEAD BY X-RAY FLUORESCENCE
J. A. Hayden 1967 10 p refs Presented at Rocky Mt. Spectry. Conf., Denver, 7–8 Aug. 1967
(Contract AT(29-1)-1106)
(RFP-990; CONF-670827-1) CFSTI: HC$3.00/MF$0.65

Three methods described for determining CeO_2 in Pb by X-ray fluorescence. The techniques are applicable to the concentration of CeO_2 ranging from ppM to major constituent levels. Ion exchange in a bromide medium is used to separate Pb from micro amounts of Ce. Microgram amounts of Ce are concentrated on ion exchange paper for analysis. Higher concentrations of Ce are analyzed in solution. Samples containing >five percent CeO_2 are analyzed without separating Ce from Pb. The relative standard deviations are 6, 2.4, and 1.1%, respectively, for the micro, macro, and high level techniques. Author (NSA)

N68-16312# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.
STUDY BY ELECTRON SPIN RESONANCE OF THE FREE RADICALS CREATED UNDER IRRADIATION IN GLYCINE [ETUDE PAR LA TECHNIQUE DE RESONANCE PARAMAGNETIQUE ELECTRONIQUE DES RADICAUX CREES SOUS IRRADIATION DANS LA GLYCINE]
Paul Thomet, Andre Rassat, Pierre Servoz-Gavin, and Henri de Choudens Aug. 1967 34 p refs In FRENCH
(CEA-R-3250)

Free radicals created by different radiations in glycine were measured by electron spin resonance and their number evaluated as a function of the absorbed dose. This number decreased when the LET of the radiations increased; high LET radiations gave less radiochemical effects, whereas high LET radiations create more damage in biological materials. The decreasing with time of the number of free radicals and the speed of this decrease was a function of temperature; by study of the kinetics of this decrease, an attempt was made to prove the presence of three radicals. Author (NSA)

N68-16314# Commissariat a l'Energie Atomique, Grenoble, (France). Centre d'Etudes Nucleaires.
NONSTOICHIOMETRY IN $U_3O_{(8\pm x)}$: ITS TEMPERATURE AND OXYGEN PRESSURE DEPENDENCE [SUR LA STOECHIOMETRIE DE L'OXYDE $U_3O_{(8\pm x)}$: INFLUENCE DE LA TEMPERATURE ET DE LA PRESSION]

Maria-Sara Rodriguez de Sastre (Salta Univ.), Joseph Philippot, and Claude Moreau May 1967 10 p refs In FRENCH
(CEA-R-3218)

The deviation from stoichiometry in uranium oxide U_3O_8, obtained by oxidation of UO_2, was studied with respect to its dependence on temperature and oxygen pressure. It is shown that the ratio $r = O/U$ increases with oxygen pressure up to 200 mm Hg at any temperature. At higher pressures, this ratio tends toward a limit that decreases with increasing temperatures. The curve $r = f(P)$ suggests a chemisorption phenomenon as the reaction-limiting mechanism. Author (NSA)

N68-16330# National Lead Co. of Ohio, Cincinnati.
THE ALPHA SPECTROMETRIC DETERMINATION OF NEPTUNIUM AND PLUTONIUM IN URANIUM PROCESS SOLUTIONS
H. W. Humphrey, B. L. Twitty, and K. M. Fritz *In its* Sum. Tech. Rept., 1 Jan.–31 Mar. 1967 Apr. 1967 8 p refs (See N68-16329 07-17)

A method was developed for analyzing neptunium (0.001 to 1.000 μg/ml) and plutonium (0.0001 to 10 μg/ml) in solutions containing as much as 500 g/l uranium. The method combines the use of a 2-thenoyltrifluoroacetone (TTA)-xylene extraction, electro-deposition from an ammonium oxalate media, and isotopic determination by alpha spectral analysis. Several methods of preparing counting samples were evaluated, i.e., evaporation, simultaneous evaporation, electroplating, and simultaneous electroplating. The precision for each phase of the analysis was determined, and the precision for the total analysis was found to be ±9.0% relative at the 95% C. L. for the stated concentrations. Author

N68-16345# Illinois Univ., Urbana.
[ON ISOTOPIC KINETICS] Progress Report, 1 Oct. 1966–30 Sep. 1967
Peter Yankwich 20 Oct. 1967 25 p
(Contract AT(11-1)-1142)
(COO-1142-77) CFSTI: HC $3.00/MF $0.65

Developments are reported for studies on: carbon isotope effects in decomposition of oxalic acid in glycerol; anomalous temperature dependence of kinetic carbon isotope effects; autocatalysis and deuterium isotope effects in reactions of formic acid and NO_2; carbon isotope effects in metal-ion oxidations of formic acid; ^{13}C isotope effects in structural isomerization of cyclopropane; temperature dependence of ^{13}C isotope effect in decarboxylation of malonic acid vapor; ^{13}C isotope effects in decomposition of hydrogen malonate ion in dioxane; intramolecular ^{13}C isotope effect in decomposition of oxalic acid in dioxane; kinetic, isotope, and stoichiometric effects in pyrolysis of manganous oxalate; flash photolysis of formic acid vapor; theoretical calculation of kinetic isotope effects, anomalous temperature dependence, and variations of reaction coordinate. NSA

N68-16356# Mound Lab., Miamisburg, Ohio.
STABLE GASEOUS ISOTOPE SEPARATION AND PURIFICATION: APRIL–JUNE 1967
G. R. Grove and R. E. Valle 30 Jun. 1967 48 p refs
(Contract AT(33-1)-GEN-53)
(MLM-1419) CFSTI: HC $3.00/MF $0.65

Research progress is reported on: carbon isotope saparation by thermal diffusion; separation of helium, neon, argon, krypton, and xenon isotopes; molecular beam scattering; transport properties; transport coefficients of neon, krypton, and helium; and low-temperature research. NSA

N68-16358# Oak Ridge National Lab., Tenn.
REDUCTION OF IRON DISSOLVED IN MOLTEN LiFThF$_4$
C. J. Barton and H. H. Stone 2 Nov. 1967 15 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-2036) CFSTI: HC $3.00/MF $0.65

Additions of ^{59}Fe tracer to LiF–ThF_4 (73 to 27 mole %) permitted rapid and sensitive measurements of the iron content of filtered samples of molten material. More than 40 hours were required for nearly complete removal of iron from the melt by hydrogen reduction at about 600°C while reduction of iron by metallic thorium at the same temperature was virtually complete after three hours. Disappearance of a relatively large quantity of solid thorium on long exposure to the molten salt will require further investigation. Comparison of the data obtained by use of ^{59}Fe tracer counts with the results of colorimetric iron determinations by two different laboratories seemed to indicate that the colorimetric iron method employed when these tests were performed did not give reliable iron results at low iron concentrations. Colorimetric nickel determinations by the two laboratories gave divergent data for more than half of the samples. Author (NSA)

N68-16374*# Florida Univ., Gainesville. Coll. of Engineering.
A STUDY OF GAS SOLUBILITIES AND TRANSPORT PROPERTIES IN FUEL CELL ELECTROLYTES Semiannual Report, 1 Mar.–31 Aug. 1967
Robert D. Walker, Jr. 9 Oct. 1967 64 p refs
(Grant NGR-10-005-022)
(NASA-CR-92997; SAR-4) CFSTI: HC $3.00/MF $0.65 CSCL 07D

This report describes work done on (1) the solubility of hydrogen and oxygen in KOH solutions, (2) the diffusivity of oxygen in KOH solutions, (3) the mutual diffusivity of water and KOH, and (4) a summary of pertinent data for the LiOH–H_2O system. The solubility of oxygen, hydrogen, and argon have been determined for the KOH concentration range of 0 to approximately 50 wt %, and up to a temperature of 80°C. The solubility of each of these gases decreases sharply with KOH concentration and somewhat less sharply with increasing temperature. Henry's law constants show little variation with temperature but are strongly dependent on KOH concentration. Heats of solution, entropies of solution, and energies of solution have been derived from the solubility data, and all of these show generally strong dependence upon both temperature and KOH concentration. For the most part, the values of the thermodynamic properties are negative, but there are a number of cases where the sign changes to positive. The diffusivity of oxygen in KOH solutions at 25°C has been determined for the four KOH concentrations. The mutual diffusivity of water and KOH has been measured for the KOH concentration range 0–10 N, and for the temperature range 25–75°C. Author

N68-16412# National Research Council of Canada, Ottawa (Ontario).
THE GROWTH OF COMPARATIVELY LARGE SINGLE CRYSTALS OF HEXAMETHYLENE TETRAMINE FROM THE VAPOUR PHASE [ZUECHTUNG GROESSERER EINKRISTALLE VON HEXAMETHYLENTETRAMIN AUS DER DAMFPHASE]
B. Honigmann 1967 12 p refs Transl. into ENGLISH from Z. Elektrochem. (Weinheim), v. 58, 1954 p 322–327
(NRC-TT-1285) CFSTI: HC $3.00/MF $0.65

A method described by Stranski and Honigmann for growing hexamethylene tetramine crystals from the vapour phase has been improved and the conditions for nucleus formation and growth have been systematically investigated. The crystals are grown in evacuated tubes placed in a metal-block thermostat. Cooling is effected by means of a copper plate pressed against the wall of the tube. The temperature of the plate can be controlled and measured. The temperature difference between the furnace and the plate is a measure of the supersaturation. Perfect crystals can be grown up to dimensions of 10×10×3 mm, and the optimum size of good crystals depends on the orientation of the crystal with respect to the substrate and on its heat conducting properties. From the different values of the frequency of nucleus formation and the different growth rates in different tubes it is concluded that nucleus

formation and growth are influenced to a considerable extent by adsorption layers on the glass substrate and the crystal surfaces. Author

N68-16417# Rocky Flats Div., Dow Chemical Co., Golden, Colo.
ANALYSIS OF LEAD ALLOYS BY ATOMIC ABSORPTION SPECTROPHOTOMETRY
G. A. Shepherd and A. J. Johnson 1967 23 p refs Presented at Rocky Mt. Spectry. Conf., Denver, 7–8 Aug. 1967
(Contract AT(29-1)-1106)
(RFP-1001; CONF-670827-2) CFSTI: HC $3.00/MF $0.65

The determination of tin in tin–lead alloys and the determination of calcium in calcium–lead alloy is accomplished by atomic absorption spectrophotometry. Solutions of the samples are analyzed using an atomic absorption spectrophotometer equipped with a 10-cm pre-mix acetylene-air burner. Tin–lead alloy samples are dissolved using fluoroboric acid, tartaric acid, and a small amount of nitric acid. Replicate analyses of an NBS lead alloy containing 4.94% tin gave an average result of 4.93% with a relative standard deviation of 2.66%. The calcium–lead alloys are put into solution with nitric acid, and lanthanum is added to eliminate possible interferences. Recoveries on prepared synthetic samples averaged nearly 100%. The relative standard deviation at a calcium content of 640 ppM was 0.30%. Author (NSA)

N68-16427*# Monsanto Research Corp., Everett, Mass.
TEST EVALUATION OF FUEL CELL CATALYSTS Quarterly Report, Aug. 16–Nov. 15, 1967
S. Matsuda and B. P. Sullivan 20 Dec. 1967 10 p
(Contract NASw-1527)
(NASA-CR-92885; QR-3) CFSTI: HC $3.00/MF $0.65 CSCL 07D

Samples of nickel; cobalt; and nickel cobalt, nickel silver, nickel silver gold alloys, along with several borides were tested for catalytic activity in the oxidation of N_2H_4. All compounds showed relatively high activities for the reaction. The borides were significantly more active than the other samples, (including their carbides and nitrocarbides. However, all compounds showed severe corrosion in 5M KOH solution, and less, but apparent corrosion in 5M KOH added with 2M N_2H_4. L.S.

N68-16430# Gesellschaft fuer Kernforschung m.b.H, Karlsruhe (West Germany). Institut fuer Heisse Chemie.
POTENTIOMETRIC TITRATION OF FREE ACID AND PLUTONIUM IN NITRIC ACID PLUTONIUM SOLUTION [POTENTIOMETRISCHE TITRATION VON FREIER SAEURE UND PLUTONIUM IN SALTPETERSAUREN PLUTONIUM-LOESUNGEN]
H. Vogg Mar. 1967 15 p refs In GERMAN Supported by EURATOM
(KFK-622; EUR-3692D) CFSTI: HC $3.00/MF $0.65

A method is described which makes use of the oxidation of plutonium (IV) to plutonium (VI) by means of manganese dioxide. The free acid is determined simultaneously with the PuO_2^{++} by way of simple potentiometric titration with alkali. In a second reaction method for the simultaneous determination of free acid and plutonium, hydrogen peroxide is added after the titration of acid, thereby freeing new H^+ ions in an amount equal to the plutonium; these new H^+ ions are then again titrated. Transl. by K.W.

N68-16434# European Atomic Energy Community, Ispra (Italy).
THE RETENTION OF ORGANIC AND INORGANIC COMPOUNDS ON CLAY MINERALS. PART 2: THE INTERACTION OF ATTAPULGUS CLAY AND POLYPHENYLIC NUCLEAR REACTION COOLANTS
R. Lopes Cardozo and D. Van Velzen Brussels Dec. 1967 43 p refs
(EUR-2646.E, Pt. 2)

The interaction of Attapulgus Clay and polyphenylic reactor coolants is shown to consist of irreversible chemisorption of oxygen containing compounds present in the highest molecular weight part of the coolant. The concentration of these compounds is estimated as 1–2% w. The saturation capacity of Attapulgus Clay is limited to approximately 5–10% w. A reaction mechanism, comprising diffusion, adsorption and reaction, is proposed. The involved set of equations is solved for the case that the resistance due to adsorption is negligible. Numerical values for the rate constants are determined. Experimental data are satisfactorily in agreement with the theoretical model. Author

N68-16445# Gesellschaft fuer Kernforschung m.b.H., Karlsruhe (West Germany).
OXIDATION OF PLUTONIUM (4) INTO PLUTONIUM (6) BY MEANS OF MANGANESE DIOXIDE [OXIDATION VON PLUTONIUM (4) ZU PLUTONIUM (6) MITTELS BRAUNSTEIN]
H. Vogg Mar. 1967 13 p refs In GERMAN Supported in part by EURATOM
(KFK-621; EUR-3690d)

Manganese dioxide was prepared from potassium permanganate in an acid medium at 60°–70°C and under addition of Cr-Ni steel shavings. The manganese dioxide was used to oxidize plutonium (IV) into plutonium (VI) in a nitric acid medium. For complete oxidation, a manganese dioxide column was found to be most favorable. The quantitative recovery of the plutonium from the column is insured with a minimum nitric acid concentration of 2 n at a minimum temperature of 30°C. Transl. by K.W.

N68-16461# Argonne National Lab., Ill.
LABORATORY INVESTIGATIONS IN SUPPORT OF FLUID-BED FLUORIDE VOLATILITY PROCESSES. PART 15: ESTIMATION OF RATES OF THERMAL DECOMPOSITION OF PLUTONIUM HEXAFLUORIDE IN PROCESS STREAMS
L. E. Trevorrow and M. J. Steindler Jul. 1967 35 p refs
(Contract W-31-109-ENG-38)
(ANL-7347) CFSTI: HC $3.00/MF $0.65

The need to predict rates of thermal decomposition of PuF_6 to PuF_4 and fluorine in fluoride volatility process streams has prompted a review of results of several types of experiments in which PuF_6 was thermally decomposed. The results of experiments with varying fluorine pressures and surface-to-volume ratios are correlated by a rate equation that expresses the dependence on those variables. $\ln(R_t - K_{eq}/R_o - K_{eq}) = k't(s/v)$, in which R_o, R_t, and K_{eq} are the mole ratios of PuF_6 to F_2 initially, after a reaction period of t minutes, and at equilibrium, respectively. The dimensions of the surface-to-volume ratio (s/v) are expressed in cm^{-1}. The dimensions of the rate constant are expressed in cm min^{-1}, and the variation of the rate constant with temperature is expressed by the equation, $\log k' = (-3169/T(°K)) + 5.364$. The latter two equations are recommended for prediction of the rate of thermal decomposition of PuF_6 in process streams in which the partial pressure of fluorine is significantly high. NSA

N68-16501# Philco-Ford Corp., Newport Beach, Calif. Aeronutronic Div.
ORGANIC RANKINE CYCLE FEASIBILITY DEMONSTRATION PROGRAM Quarterly Report, 17 Jul.–30 Sep. 1967
16 Oct. 1967 31 p
(Contract AT(04-3)-650)
(PRP-67-1184; QR-6) CFSTI: HC $3.00/MF $0.65

The data are summarized for the 1000 hr recirculation boiler test of MIPB for its thermal breakdown characteristics. After 1000 hr, approximately 10% of the MIPB had been converted, mostly to other biphenyl compounds. Gas analysis and the evidence of 0.5% heavy compounds indicated the expected dehydrogenation and condensation typical of thermal degradation. No appreciable boiler fouling occurred, but the generation of 0.04 scf/day of gas was established. The presence of a leak of approximately 0.003 scf/day of inducted air was fairly well established. Highly detailed

liquid and gas analyses were conducted. The plan of the next test run is described. A 5000 hr endurance test will be run for an essentially direct comparison with data on biphenyl and Dowtherm as generated by the Sundstrand Corporation. A once-through salt-bath heated boiler will be used. Author (NSA)

N68-16509*# Southern Research Inst., Brimingham, Ala.
A STUDY OF POLYMERS CONTAINING SILICON–NITROGEN BONDS Annual Summary Report, 4 May 1966–3 Jun. 1967
Robert E. Burks, Jr. and Joseph L. Greene, Jr. 17 Jul. 1967 116 p refs
(Contract NAS8-20190)
(NASA-CR-61548; Rept.-25) CFSTI: HC $3.00/MF $0.65 CSCL 11J

Methods of preparing poly[1,4-bis(oxydimethylsilyl) - benzene diphenylsilane] in molecular weights up to 400,000 were improved, and the polymer was studied as a source of high-temperature elastomers and pressure-sensitive adhesives. A polysilphenylene amine was studied as a source of protective coatings and resilient foams. The polysilphenylene amine pigmented with aluminum formed coatings on titanium, stainless steel, and mild steel that underwent no visible change at 540°C in several hundred hours. Foams made by crosslinking the polysilphenylene amine with pentaerythritol had good thermal stability for resilient polymers, but they also had poor strength. An epoxy resin cured with bis(methylamino)diphenylsilane was prepared for evaluation as a heat barrier. The same resin had good thermostability as an adhesive for aluminum lap joints. The silylation of polyvinyl alcohol, the hydrolysis and condensation of silyamines, the reaction of bis(methylamino)diphenylsilane with ketones, and the polymerization of isocyanates with silazanes were also isocyanates with silazanes were also investigated. Author

N68-16528*# IIT Research Inst., Chicago, Ill. Technology Center.
STUDY OF CONVERSION OF FORMALDEHYDE INTO SUGAR-LIKE PRODUCTS Final Report, Mar. 24, 1967–Jan. 23, 1968
Charles H. Riesz 23 Jan. 1968 36 p refs
(Contract NAS2-4184)
(NASA-CR-73180; IITRI-U-6062-9) CFSTI: HC $3.00/MF $0.65 CSCL 07C

The feasibility of synthesis of sugar-like products by γ-irradiation of formaldehyde absorbed on molecular sieve zeolites was demonstrated. The conversion and product distribution are dependent upon both the type of zeolite as well as the channel configuration and dimensions. Use of Type A and X zeolites increased the conversion into total product from at least 10 to as much as 1000-times higher than when no matrix was present (paraformaldehyde). A mechanism was proposed, dependent upon formation of electron hole traps in the zeolites which stabilize free radicals incident to the synthesis. Maximum molecular size is limited by the 11–12Å cavity dimensions of the A and X zeolites. For straight- chain monosaccharides, the largest molecule contains approximately 9–10 carbon atoms. With a decationized zeolite (Zeolon-H), the pores are tunnel-like and the maximum molecular size is not limited. Author

N68-16568*# Peninsular ChemResearch, Inc., Gainesville, Fla.
DEVELOPMENT OF VULCANIZABLE ELASTOMERS SUITABLE FOR USE IN CONTACT WITH LIQUID OXYGEN Annual Summary Report, 9 May 1965–8 May 1966
Paul D. Schuman 8 Jun. 1966 139 p refs
(Contract NAS8-5352)
(NASA-CR-93172; ASR-3) CFSTI: HC $3.00/MF $0.65 CSCL 11J

Three members of a homologous series of fluorocarbon vinyl ethers were prepared. Copolymerization of $CF_3OCF=CF_2$, $C_3F_9OCF=CF_2$ and $C_3F_7OCF=CF_2$ with CF_3NO, when run at high pressure, yields high molecular weight nitroso polymers. The T_g of these polymers ranged between −1° and −7.5°. Copolymers of the three vinyl ethers with $CF_2=CH_2$ gave excellent elastomeric polymers. Terpolymers of $CF_3OCF=CF_2$, C_2H_4, C_2F_4 were prepared. Unlike the Co^{60} initiated copolymerization of $(CF_3O)_2C=CF_2$ with C_2F_4 or with $CF_2=CH_2$, it was found possible to prepare these copolymers at 1000 atm. pressure using a free radical initiator. The copolymer of $(CF_3O)_2C=CF_2$ with $CF_2=CH_2$ was found to melt at 150 to 160° and was molded into a transparent, tough film. Variable results were obtained in attempts to copolymerize CF_3CHO with C_2F_4. Reaction of $CF_3OCHFCFC1OCF_3$ with KOH results in dehydromethoxylation rather than the expected dehydrochlorination. Author

N68-16572# National Bureau of Standards, Washington, D. C. Spectrochemical Analysis Section.
X-RAY WAVELENGTH CONVERSION TABLES AND GRAPHS FOR QUALITATIVE ELECTRON PROBE MICROANALYSIS
Kurt F. J. Heinrich and Mary Ann M. Giles 25 Sep. 1967 63 p ref
(NBS-TN-406) GPO: HC $0.70; CFSTI: MF $0.65

Tables and graphs have been constructed for electron probe X-ray spectrometers equipped with crystal changers and calibrated for LiF crystals in angstroms. These tables indicate the equivalent reading for the lines which can be normally expected to appear in wavelengths scans using the following crystals: LiF, EDDT, ADP, KAP, and Pb stearate (LSD). The tables are arranged by the atomic numbers of the emitting elements; the graphs show the readings for observable lines as a function of atomic number for each of the aforementioned crystals. A suggested method for using the tables and graphs is included. Author

N68-16597# Bureau of Mines, Boulder City, Nev.
LOW-TEMPERATURE CHLORINATION OF FERROCHROMIUM: PRELIMINARY STUDIES
R. L. de Beauchamp and T. A. Sullivan Mar. 1968 11 p refs
(BM-RI-7088)

Investigated was the extraction of chromium from ferrochromium by low-temperature chlorination in the 340° to 525°C range. The objective was to devise a method for separating chromium from iron in high-carbon ferrochromium produced from domestic chromite concentrates. The majority of iron was removed as a volatile chloride; chromium was contained in the residue as a nonvolatile chloride, which was separated from carbon and unattacked ferrochromium by dissolution. A small rotary chlorination apparatus was designed, built, and used for the chlorination tests, and samples of commercial-grade high- and low-carbon ferrochromiums were chlorinated for comparison of chlorination characteristics. Low-temperature chlorination of three types of ferrochromium resulted in the removal of 81.9% to 91.6% of the iron content as sublimed $FeCl_3$. Recovery of chromium in a leach solution of the reactor product varied from 82.4% to 93.1%. Author

N68-16601# Japan Atomic Energy Research Inst., Ibaraki.
STRESS IN THE OXIDE FILMS OF ZIRCONIUM AND ZIRCALOY-2 DURING ANODIC OXIDATION
Sueo Nomura, Cho Akutsu and Ichiro Saruyama (Mitsubishi Atomic Power Ind., Inc.) Dec. 1967 16 p refs Transl. into ENGLISH from Denki Kagaku (Tokyo), v. 33, no. 10, Oct. 1965 p 723–727
(NSJ-TR-94) Available from Div. of Tech. Inform., Japan Atomic Energy Res. Inst.

The stress studies with pure zirconium (Zr) and Zircaloy-2 (Zry-2) were conducted at room temperature. If the deformation occurred within its elastic limit, the calculated stress was found to be as large as 50 kg/mm^2. Consequently, cracks may be produced in the oxide film, which was confirmed by the electron-microscopic observation. The stress tended to approach a certain definite value when the depth of oxide films was above 2000 ≈ 3000 Å, and the cracking phenomenon became larger beyond this point. The stress

was measured also for pure Zr and Zry-2 in which 2000 ppm O_2 was dissolved as a solid solution; pure Zr was smaller in stress than in Zry-2 and the original Zry-2 was smaller in stress than the treated (with oxygen) Zry-2, in the oxyde films. The bending phenomenon at elevated temperatures was observed, and the stress in the oxide film at elevated temperatures was estimated. Author

N68-16654# Babcock and Wilcox Co., Lynchburg, Va. Nuclear Development Center.
GEL-ADDITION PROCESS CHEMICAL STUDIES Quarterly Progress Report, Apr.–Jun. 1967
E. H. Dewell, comp. Nov. 1967 39 p refs
(Contract AT(30-1)-3714)
(BAW-3714-4; QPR-4) CFSTI: HC $3.00/MF $0.65

Development of the gel-addition process for mixed urania–plutonia fuels was continued. UO_2 sols were prepared by the ORNL Formate Process. Gel spheres were made by drying sol droplets in a recirculating column containing a 2-ethylhexanol bath. Carbon analyses at various steps showed that at least half the carbon added (as urea and formate during sol preparation) remains in the sol. Gelation roughly tripled the carbon level (C/U atoms ratio in gel ≈ 1.5). A study of the gelation bath composition showed that nitrated organics do not appear in sufficient quantity to constitute a hazard. Oxidation of Pu(IV) to Pu(VI) by nitrate was confirmed to be first order in Pu(IV). Apparent half-times were measured at 30 and 10 min. Plutonium pickup by UO_2 gel was found to be extremely rapid. In contacting runs lasting between 10 and 20 seconds, Pu/U + Pu reached several percent from Pu(IV) solutions. Ceramographic procedures were developed for polishing and photographing unfired gel. Most gel samples examined show cracking. capsule design for in-pile testing of mixed oxide is complete. Author (NSA)

N68-16680# University Coll., London (England). Dept. of Chemistry.
SYNTHESIS AND STRUCTURE OF NEW TYPES OF METAL ORGANIC COMPLEXES Final Scientific Report, 1 Oct. 1962–30 Sep. 1966
Ronald Nyholm and M. L. Tobe Oct. 1967 15 p refs
(Contract N62558-3589)
(AD-663164) CFSTI: HC $3.00/MF $0.65

A series of ligands containing three or more tertiary arsenic atoms was prepared. The coordinating properties of many of these ligands were examined and the complexes of the most promising ligands were studied in detail. The various attempts to prepare ligands that are able to form carbon to metal bonds by direct reaction with a metal or its halide are described. The stabilisation of a carbon to metal bond by making the ligand polydentate was finally achieved by an alternative approach. A series of terdentate oxygen donor ligands was prepared in the hope that the general polymeric form of the alkoxides of T1(I) could be reduced to a monomeric form if the alkoxide was part of a terdentate ligand. The resultant compounds remained polymeric and the conclusions drawn about the tendency of T1(I) to form clusters are discussed. Some interesting complexes of carbon with a ditertiary arsine are described. The attachment of more than one arsenic to an aliphatic carbon appears to make the carbon susceptible to electrophilic attack. The remaining hydrogens are readily exchanged in protonic solvents and halogens, if present, are rapidly replaced by hydrogen if the compounds come into contact with water. Author (TAB)

N68-16693# Naval Radiological Defense Lab., San Francisco, Calif.
ADSORPTION OF TRACE ELEMENTS FROM SEAWATER BY CHELEX 100
Harry A. Goya and Ming G. Lai 8 Sep. 1967 16 p refs
(ARPA Order 961)
(USNRDL-TR-67-129; AD-663129)

Chelex 100 was evaluated as an ion-exchange resin for the extraction of trace elements from seawater. A modification of the limited bath technique was used, in which resin was added to a solution containing the trace element. After time for equilibration, the solution was analyzed and the fraction of the activity adsorbed by the resin was determined. Chelex 100 appears to be an excellent ion-exchanger for extracting a number of trace elements from seawater. These include: Ni, Zn, Ce, La, Tm, Pb, Am, Tb, Mn, Bi, Pu, Cr, Th, Co, Cd, Fe, and Hg. Author (TAB)

N68-16701# International Union of Pure and Applied Chemistry, Basle (Switzerland). Commission on High Temperature and Refractories.
BIBLIOGRAPHY ON THE HIGH TEMPERATURE CHEMISTRY AND PHYSICS OF GASES AND PLASMAS
L. Brewer, comp. (Calif. Univ., Berkeley) 30 Sep. 1967 21 p refs Sponsored in part by the Natl. Bur. of Std. *Its* Bibliog. No. 24
(NP-17130) Available without cost from Natl. Bur. of Std., Washington, D. C.

Two hundred references on spectroscopy of interest to high-temperature chemistry and on reactions between gases and condensed phases are listed. NSA

N68-16718# Stauffer Chemical Co., Adrian, Mich. Silicone Div.
RESEARCH IN SYNTHESIS AND CHARACTERIZATION OF HIGHLY ARYLATED ORGANOSILICON COMPOUNDS Final Report
K. C. Pande, G. M. Hart, J. W. Ezell, S. R. Gudemoos, and D. C. Smith Wright-Patterson AFB, Ohio ARL Jul. 1967 23 p refs
(Contract AF 33(615)-3246)
(ARL-67-0159; AD-663240)

A series of six organomonofluorosilanes was prepared via the corresponding chlorosilane analogs by derivatization of the appropriate chlorosilane intermediates with 1-naphthyllithium followed by rehalogenation with a suitable inorganic fluoride. Aqueous hydrofluoric acid (10%) was used in all but the single case of an Si-H-containing compound for which a hexafluorosilicic acid reagent was found to be satisfactory. Author (TAB)

N68-16727 Oklahoma Univ., Norman. Dept. of Physics
LINEWIDTHS OF THE ROTATIONAL SPECTRA OF SYMMETRIC-TOP MOLECULES
James A. Roberts, T. K. Tung, and Chun C. Lin [1967] 16 p refs Sponsored in Part by NSF

Measurements of linewidths are reported for some fifty rotational transitions ($J \rightarrow J + 1$) of the CH_3C^{35}, CH_3C^{37}, CH_3Br^{79}, CH_3Br^{81}, CH_3I, CH_3CN, and CH_3CCH molecules. The CH_3CN molecule has exceptionally wide lines (100 Mc/sec-Torr) due to the large dipole moment (3.92D). The experimental data are compared with the theoretical widths which are calculated using the Anderson theory with dipole-dipole interaction. With the exception of the CH_3CCH molecule, the theoretical widths are larger than the experimental ones. The overall agreement between theory and experiment is within 30%. Author

N68-16745# Purdue Univ., Lafayette, Ind.
SOME ORTHOSILICATES AND THEIR HYDRATES Final Report
L. E. Campbell 20 Jun. 1967 168 p refs Prepared jointly with Indiana State Highway Comm. and Bur. of Public Roads
(PB-17671)

The early reactions of several alkaline-earth orthosilicates with excess water were studied. The anhydrous compounds used were the orthosilicates of barium, magnesium, cadmium, strontium, and calcium–the last in both the beta and gamma phases. The objectives were to determine the processes of early hydration reactions, the activation energies involved, and the nature of the final

product of the reaction. The anhydrous silicates were mixed with a large excess of water so that no saturation of the water with dissolved species occurred. Under these conditions, the reactions were studied without the rate-controlling diffusion conditions present in more concentrated systems, e.g., cement paste. The reactions were followed conductimetrically and the variables controlled were sample size, initial concentration of alkaline-earth hydroxide, temperature, and surface area of anhydrous orthosilicate. The hydrated products were found to be orthosilicates, with molar metal to silica ratios of about 1. Author

N68-16754# Florida Univ., Gainesville. Engineering and Industrial Experiment Station.

THE DIAPHRAGM-CELL METHOD FOR MEASURING DIFFUSION COEFFICIENTS IN BINARY LIQUID MIXTURES

K. E. Gubbins and R. N. Bhatia Sep. 1967 42 p refs *Its* V. 11, No. 9
(TP-390)

A review is presented of theoretical and experimental aspects of the diaphragm-cell technique for determining diffusion coefficients in binary liquid mixtures. Limitations of the method are discussed, together with necessary experimental precautions, and methods of calculating the differential diffusion coefficient are compared. A literature survey is given which covers the development of this technique up to June 1967. Author

N68-16773# Los Alamos Scientific Lab., N. Mex.

THE DETERMINATION OF OXYGEN AND CARBON IN GERMANIUM BY ^{3}He ACTIVATION

Dale M. Holm, William L. Briscoe, Jack L. Parker, William Mort Sanders, and Sam H. Parker 1967 31 p refs Presented at 2d Intern. Meeting on Pract. Aspects of Activation Analysis with Charged Particles, Liege
(Contract W-7405-ENG-36)
(LA-DC-8994; Conf-670947-1) CFSTI: HC $3.00/MF $0.65

Channeling of ^{3}He ions in single-crystal germanium and its application to activation analysis is being investigated. Crystal orientation was determined by directing a beam of low angular divergence and energy onto the crystal and observing the decrease in counting rate from Rutherford backscattered particles as a function of incident beam angle. Some samples were activated with the beam aligned along the [111] axis of the crystal and others with the beam purposely misaligned from that axis. Samples of germanium from different sources were analyzed, and typical values of 10 ppM oxygen and 40 ppM carbon were obtained. Slight activation of the germanium was found at 6.5 MeV and serious activation at 8 and 12 MeV. Autoradiography was performed on some of the samples following activation to aid in the interpretation of the results. Author (NSA)

N68-16774# Academia R. P. R., Bucharest. Institutul de Fizical Atomica.

ESR STUDY OF SOME CR(6) IRRADIATED COMPOUNDS

O. Constantinescu, I. Pascaru, and M. Constantinescu Jun. 1967 12 p refs
(IFA-ESR-16)

The behavior on radiolysis of $CrO_4(NH_4)_2$ and CrO_2K_2 were studied. In the case of polycrystalline $CrO_4(NH_4)_2$ irradiated with γ rays and with neutrons, the formation of Cr(V) and Cr(III) was observed. The spectra of CrO_4K_2 irradiated under the same conditions, suggested the formation of radicals of CrO_3 type. A mechanism of the production by radiolysis of the paramagnetic species formed was proposed. Author (NSA)

N68-16791# United Kingdom Atomic Energy Authority, Harwell (England).

THE EFFECT OF GAMMA RAYS ON THE SYNTHESIS OF ORGANO-METALLIC STABILISERS AND CATALYSTS FOR PLASTICS

K. A. Kotchechov, N. I. Cheverdina, and L. V. Abramova Aug. 1966 10 p refs Transl. into ENGLISH from the 31st Intern. Congr. of Ind. Chem. (Liege), 7–20 Sep. 1958 p 331–333 CFSTI: HC $3.00/MF $0.65

This paper describes the direct production of organo-tin compounds from aliphatic halides and tin. Up till now, however, this synthesis was limited to the lower aliphatic halides at high temperatures (200 to 300°), or it could only be effected by indirect preparation from R_4Sn. The authors' work shows that irradiation with gamma rays (Co^{60}) of a mixture of alkyl halides and tin powder gives rise to the direct and easy formation of R_2SnX_2 at ordinary temperatures and pressures. The yields are quite satisfactory. The reaction may be assumed to be a chain reaction. It should be noted that ultra-violet radiation produces no effect. The products obtained differ from those which were synthesised by thermal reaction, in that they only contain very little R_3SnX. Author

N68-16840*# National Aeronautics and Space Administration, Washington, D. C.

MORSE POTENTIAL PARAMETERS FOR C-C, C-O, AND C-N INTERACTIONS

I. B. Rozhdestvenskiy, N. N. Tsitelauri, N. V. Voskresenskaya, and Ye. V. Samuylov *In its* Studies in Phys. Gas Dyn. Feb. 1968 p 1–12 refs (See N68-16839 07-12)

Reported are values of Morse potential parameters for interactions of atoms in diatomic molecules of C_2, CO, and CN which were derived using the Rydberg–Klein–Rees method. S.C.W.

N68-16900# Nuklearni Institut Jozef Stefan, Ljubljana (Yugoslavia).

NMR INVESTIGATION OF HYDRATED URANIUM DIOXIDE

R. Blinc, B. S. Brcic, M. Komac, D. Kolar, M. Pintar et al Sep. 1967 10 p refs Presented at Intern. Congr., Torino, Italy, Oct. 1967
(NIJS-R-509)

Preliminary nuclear magnetic resonance data suggest a large amount of hydrate water in $UO_2 \times H_2O$ prepared from dilute UCl_4 solution by the addition of ammonia at 60°C. It was, however, demonstrated, that the composition of $UO_2 \times H_2O$ depends upon the preparation conditions. M.W.R.

N68-16926# Argonne National Lab., Ill.

USE OF XENON DIFLUORIDE FOR THE SYNTHESIS OF LABELED PERIODATES

I. S. Kirin, V. K. Isupov, V. I. Tikhonov, N. V. Ivannikova, Yu. K. Gusev et al 1967 4 p refs Transl. into ENGLISH from Zh. Neorg. Khim. (Moscow), v. 12, 1967 p 1088–1089
(ANAL-TRANS-538) CFSTI: HC $3.00/MF $0.65

A labeled potassium periodate was prepared by the interaction of potassium iodate labeled with the isotope ^{131}I and xenon difluoride. The formation of oxygen compounds of ^{131m}Xe during the β-decay of ^{131}I in the synthesized potassium periodate has been established. Author (NSA)

N68-17003# Mound Lab., Miamisburg, Ohio.

MOUND LABORATORY PROGRESS REPORT FOR CHEMISTRY, JANUARY–MARCH 1967

13 Oct. 1967 62 p refs
(Contract AT(33-1)-GEN-53)
(MLM-1405) CFSTI: HC $3.00/MF $0.65

Developments are reported for studies on: determination of coincidence correction; half-life determination by decaying pairs; residue adsorption; alpha-beta branching ratio of ^{217}Ac; half-life of ^{210}Po; thermal dehydration of uranyl nitrates; studies of catalyst for dissolution of Pu(IV) oxide; chelates of Eriochrome Blue Black-R; separation of small quantities of B in KCl–KF; ^{234}U

recovery; ^{229}Th recovery; techniques for measuring internal conversion coefficients; gamma assay of ^{238}Pu in waste; determination of ^{95}Zr and ^{95}Nb by gamma counting; NMR analyses of tropolone complexes of U; spectrographic studies of lead analysis; spectrographic analysis of Si; stilbene crystal, fast-neutron spectrometer; modified electron beam measurement of thermal diffusivity; and X-ray diffraction analysis. NSA

N68-17051*# Whittaker Corp., San Diego, Calif. Narmco Research and Development Div.

THE DEVELOPMENT OF STRUCTURAL ADHESIVE SYSTEMS SUITABLE FOR USE WITH LIQUID OXYGEN Annual Summary Report, 1 Jul. 1964–30 Jun. 1965

Jerome Hollander, Floyd D. Trischler, Edward S. Harrison, Richard T. Rafter, and Luis Acle Jul. 1965 191 p refs

(Contract NAS8-11068)

(NASA-CR-77315; ASR-2) CFSTI: HC $3.00/MF $0.65 CSCL 11I

Nine new highly halogenated polyurethanes and one new highly halogenated polycarbonate were prepared and tested for liquid oxygen (LOX) compatibility along with the seven highly halogenated polymers. The results indicate that urethane linkages flanked on the alcohol side by a 1,1-dihydroperfluoroalkyl chain are stable to impact in LOX if the nitrogen is attached to a difluoromethylene, a tetrafluoro-p-phenylene, or a tetrachloro-p-phenylene group. Urethane, amide, and ester groups do not, in themselves, impart LOX incompatibility. Polyurethanes prepared from hexafluoropentanediol were LOX compatible but those prepared from certain modified diols were not. A number of other halogenated polymers such as polyamides, polyimides, ployureas, a polyester, a polycarbonate, and a polysulfite were synthesized. Preparations of synthetic studies have been carried out on additional monomers and prepolymers including halogenated diisocyanates and polyethers. Author

N68-17076# General Electric Co., Pleasanton, Calif. Nucleonics Lab.

DETERMINATION OF NEODYMIUM-148 IN IRRADIATED URANIUM AND PLUTONIUM AS A MEASURE OF BURNUP

B. F. Rider, C. P. Ruiz, J. P. Peterson Jr., and F. R. Smith 30 Oct. 1967 30 p refs

(Contract AT(04-3)-189)

(GEAP-5354) CFSTI: HC $3.00/MF $0.65

Nonradioactive fission-product ^{148}Nd was determined by isotopic dilution mass spectrometry. The isotopic diluent was a blend of ^{150}Nd, ^{233}U, and ^{242}Pu. After an ion exchange separation of Pu, U, and Nd, each fraction was mounted on a Re filament for mass spectrometric analysis. Burnup (atom percent fission) was computed from the ^{148}Nd-to-fuel ratio to an accuracy of 1.2% (1 σ), which includes a 0.7% single instrument uncertainty in the ^{148}Nd-to-fuel ratio and a 1.0% uncertainty in the ^{148}Nd fission yield. Author (NSA)

N68-17129# Centre de Recherches Nucleaires, Strasbourg (France).

DEVELOPMENT OF METHODS FOR LABELLED ORGANIC COMPOUNDS [DEVELOPPEMENT DE METHODES DE MARQUAGE DE COMPOSES ORGANIQUES] Final Report

J. P. Adloff, R. Bertrand, C. Gerardin, and J. M. Paulus Brussels EURATOM Jan. 1968 62 p refs In FRENCH; ENGLISH summary

(Contract EURATOM-076-64-3 RISF)

(EUR-373.f) CFSTI: HC $3.00/MF $0.65

This report describes development of unconventional labelling methods. 1. Labelling of butane under the impact of tritium ions in the energy range between 3 eV and 6000 eV. A mass spectrometer has been designed to produce tritium ions with controlled energy and to study the interaction of these ions with gaseous targets. The results of the irradiation of butane are presented, as a function of the particle energy and the pressure of the target. The incorporation of tritium into butane is low and does not exceed 4% in the best conditions. 2. Electric discharge-induced labelling. Results of a high frequency electric discharge in methane-^{14}C alone and admixed with halogen vapours are presented. It is shown that the synthesis leads in several seconds to the formation of higher hydrocarbons and halocarbons with the same specific activity as the methane. 3. Tritiation of hydrocarbons and their derivatives by exchange labelling with the complex of tritiated phosphoric acid and boron trifluoride. Author

N68-17140# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.

INFLUENCE OF TEMPERATURE ON THE TRACER-LEVEL SEPARATIONS BY ION EXCHANGE CHROMATOGRAPHY [WPLYN TEMPERATURY NA ROZDZIELANIE SLADOWYCH ILOSCI SUBSTANCJI METODA CHROMATOGRAFII JONITOWEJ]

Rajmund Dybczynski 1967 28 p refs Submitted for publication

(Rept.-840/VIII/C) CFSTI: HC $3.00/MF $0.65

A discussion of the effect of temperature on separation of trace amounts of substances by ion exchange chromatography is presented. The overall influence of temperature on final resolution of chromatographic peaks consists of corresponding contributions due to the changes of separation factor and of plate height. Both separation factor and the plate height can either decrease or increase or remain constant with the rise in temperature depending on the separated species and ion exchange system employed. A general classification of possible changes in resolution resulting from the variation of separation factor and of plate height has been given, and numerous examples are presented. Author

N68-17149# National Research Council of Canada, Ottawa (Ontario).

FREEZING OF ENERGY TRANSFER IN ORGANIC MIXED CRYSTALS [DAS EINFRIEREN DER ENERGIEUEBERTRAGUNG IN ORGANISCHEN MISCHKRISTALLEN]

K. Gschwendtner and H. C. Wolf 1967 4 p refs Transl. into ENGLISH from Naturwissenschaften (Berlin), v. 48, no. 2, 1961 p 42–43

(NRC-TT-1268)

Electronic excitation energy in organic crystals can be transferred without radiation to guest molecules. At extremely low temperatures the energy transfer should than be frozen along with the lattice vibrations. In order to clarify the transfer mechanism, the dependence of the sensitized fluorescence on temperature is measured in a number of mixed crystals. Author

N68-17183# Japan Atomic Energy Research Inst., Tokyo.

STUDIES ON SEPARATION OF FISSION PRODUCT BY FLOTATION METHOD—SEPARATION OF ^{137}Cs

Yoshio Koyanaka Dec. 1967 11 p refs Submitted for publication

(NSJ-TR-90)

Flotation has proven to be effective in removing ^{137}Cs from its aqueous dilute solution, with the aid of a suitable coprecipitant such as cupric or nickel ferrocyanide and pertinent collectors such as sodium oleate and octadecylamine acetate. It has been found in the experiments on single stage flotation that 90≈99% of ^{137}Cs can be removed by optimum choice of the concentrations of coprecipitant and collector, as well as of pH of flotation medium. Multiple flotation for four successive stages gave a decontamination factor of 10^4 to 10^6 with a volume reduction ratio of higher than 50. Author

N68-17192# Comision Nacional de Energia Atomica, Buenos Aires (Argentina).

DETERMINATION OF URANIUM WITH A POTENTIAL-CONTROLLED COULOMETRIC TITRATOR [DETERMINACION DE URANIO CON UN TITULADOR CULOMBIMETRICO A POTENCIAL CONTROLADO]

Walter J. Krause and G. A. Dupetit 1967 25 p refs In SPANISH; ENGLISH summary
(CNEA-192)

The determination of uranium in the 2 to 20 mg per sample range with a potential-controlled coulometric titrator has been studied for the subsequent determination and control of the uranium concentration in solutions arising from the various phases in the irradiated fuel reprocessing plant. Therefore, the method is available in presence of aluminum and nitric in relatively large amounts and permits small quantities of Fe(III) and Hg(II). The determination is based on the U(VI)–U(IV) reduction in a potential-controlled mercury cathode cell, using 1M sulphuric acid as supporting electrolyte. The reduction mean time oscillates between 12 and 18 minutes and the obtained results agree within a standard deviation of 0,1 to 0,8%. A general outline about the electrical calibration of the titrator is given too, using furthermore an iron standard solution and a platinum electrode cell. Author

N68-17199# IIT Research Inst., Chicago, Ill.
ENERGY TRANSFER AND RADIATION PROTECTION IN THE RADIOLYSIS OF POLY(METHYL METHACRYLATE) STEREOISOMERS AND COPOLYMERS
George A. Henry (Ph.D. Thesis) Jun. 1967 119 p refs
(Contract AT(11-1)-1224)
(COO-1224-15) CFSTI: HC $3.00/MF $0.65

Electron and ultraviolet irradiation of poly(methyl methacrylate) containing different additives and of syndiotactic and isotactic poly-methyl methacrylate were carried out. Studies were made to see whether protection of the poly(methyl methacrylate) by energy transfer to the additives (e.g., cumene and α-methylstyrene) occurred, and whether either intermolecular or intramolecular energy transfer was the dominant mode in these systems. The effects of irradiation on mixtures of isotactic and syndiotactic poly(methyl methacrylate) were also investigated. A mathematical treatment involving the use of Markov chain theory was used to explain the results. The electron irradiations were carried out with 13 MeV electrons from a linear accelerator. Thin films of polymer samples were irradiated with 2537 Å ultraviolet light. The degradation of the polymers was followed by the change in molecular weight as measured by viscometry of dilute solutions in benzene. Results indicated that isotactic poly(methyl methacrylate) is more stable to electron and uv irradiation than syndiotactic poly(methyl methacrylate). Mixtures of these stereoisomers formed by dissolving the polymers in methylene chloride when irradiated (as thin films), with ultraviolet light, displayed enhanced stability in the region of 30 to 50 wt % isotactic isomer. This is probably due to the formation of a stable complex between the stereoisomers. For the case of electron irradiation of polymethyl methacrylate containing cumene and α-methylstyrene the mathematical treatment showed that energy transfer to the sinks is from 20 to 40 times more probable than internal conversion. For ultraviolet irradiation, energy transfer to the sinks was five times as probable. In addition energy migration was primarily intramolecular. The Markov chain treatment also showed that the energy transfers by a series of random jumps. Author (NSA)

07 COMMUNICATIONS

Includes communications equipment and techniques, noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N68-16161*# Communications Systems, Inc., Falls Church, Va.
TIME DIVISION ACCESS FEASIBILITY STUDY MODULATION AND SYNCHRONIZATION CONSIDERATIONS
G. F. Dooley and P. C. Jain Oct. 1967 57 p refs
(Contract NASw-1218)
(NASA-CR-92715; Rept.-453330) CFSTI: HC $3.00/MF $0.65
CSCL 17B

The feasibility of the time division access system (TDA), and the development of an optimizing technique for a small user access system for satellite communication were investigated. The system consists of a large number of small ground stations, each requiring only a low capacity. A figure of merit is derived for a TDA system, and it is shown that optimization of this figure of merit is equivalent to maximizing the number of accesses for a given received carrier to noise density ratio. The figure of merit includes the effects of Rf, bit and frame synchronization efficiencies, and effective energy per bit to noise density ratio. Various techniques are examined and their effect on the figure of merit is analyzed. Numerical examples are used to demonstrate the effects and their interrelationships in a quantitative manner. Author

N68-16254*# Harvard Coll. Observatory, Cambridge, Mass.
GROUND FEASIBILITY TESTS OF UNITY-GAIN, HIGH DIRECTIVITY ANTENNA Final Report
G. Richard Huguenin Jan. 1968 65 p
(Contract NSR-22-007-072)
(NASA-CR-92992; HSRP-110) CFSTI: HC $3.00/MF $0.65
CSCL 09F

A four dipole, high directivity antenna array was designed, built, and tested to evaluate the usefulness of a gate processing antenna system for long wavelength radio astronomy. For comparison purposes, a 64-element array which produced the design goal of the 4-element array (a 10 arc-degree pencil beam) was also constructed. The feasibility tests demonstrated that the system can provide at least a 10 arc-degree pencil beam with low sidelobes for signal-to-backgroud ratios greater than unity. As the signal-to-background ratio became less than unity, the beam slowly degenerated. The processed beam, however, was always narrower than the signal beam. It was concluded: (1) The primary cause of the beam degeneration was the non-ideal nature of the transistors used as diodes in the 6-U gates and that this situation could be improved by more careful selection of existing devices, or the development of special solid state devices. (2) The system can provide for at least 10 arc-degrees for observing intense and sporadic solar system radio sources and therefore is complimentary to aperture synthesis radio astronomy systems. (3) The original aim of the system—to map the cosmic noise background—cannot be met. E.J.S.

N68-16295*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
CURRENT AND DRIVING POINT IMPEDANCE COMPUTATIONS FOR LONG RESONANT ANTENNAS
Patricia A. Comella Dec. 1967 17 p refs
(NASA-TM-X-63087; X-642-67-619) CFSTI: HC $3.00/MF $0.65
CSCL 09F

The solution of the Hallen integral equation for a resonant cylindrical antenna is presented in a simple trigonometric form. The method of solution is discussed. A Romberg integration scheme, used in the antenna calculations, is given. The computations are discussed and a sample of results is shown. Author

N68-16343*# Little (Arthur D.), Inc., Cambridge, Mass.
A PROGRAM OF RESEARCH DIRECTED TOWARD THE EFFICIENT AND ACCURATE MACHINE RECOGNITION OF HUMAN SPEECH. A THEORY OF SPEECH PERCEPTION Final Report
Huseeyin Yilmaz 14 Nov. 1967 41 p refs
(Contract NAS12-129)
(NASA-CR-86027; C-68366; FR-2) CFSTI: HC $3.00/MF $0.65
CSCL 09D

The author's theory of speech perception, as applied to time-dependent speech sounds, leads to many testable predictions. While some of these predictions are consistent with conventional knowledge, others are new and quite unexpected. A few are in contradiction to long accepted experimental results. A computer-aided experimental program, designed to test the theory, wholly supported these predictions. In view of this outcome, it seems desirable to test other predictions of the theory and to reexamine some conventionally accepted views in order to arrive at a more comprehensive theory of speech. The present findings indicate that, apart from categorization, consonants are similar to vowels: they exhibit parallel organizations and transformation properties. Author

N68-16350# Joint Publications Research Service, Washington, D. C.

SPACE COMMUNICATIONS SYSTEMS AND INFORMATION TRANSMISSION

Yu. K. Khodarev 21 Feb. 1968 9 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 5, no. 5, 1967 p 680–685
(JPRS-44962) CFSTI: HC $3.00/MF $0.65

A chronological account is presented on the development of space communications systems, starting with the launch of the first Sputnik in October 1957. Also discussed is an experimental communication system, initiated in 1965, which provides multichannel telephone–telegraph duplex communication and television transmission; remote interplanetary communication; telemetry data transmission; required energy levels for onboard power sources; optical communication; and onboard data processing. M.G.J.

N68-16361* Lockheed Missiles and Space Co., Sunnyvale, Calif.

ADVANCED TELEMETRY SYSTEM WITH ADAPTIVE CAPABILITY, PHASE 5 AND PHASE 7 Final Technical Summary Report, 1 Mar. 1966–31 Jul. 1967

E. Graeve and H. N. Massey 4 Aug. 1967 309 p refs
(Contract NAS8-5110)
(NASA-CR-92673; LMSC-A880609) CFSTI: $3.00 CSCL 09F

Detailed technical accomplishments are reported in the design of a hybrid ZVA/FVA (zero-order interpolator; first-order interpolator) breadboard data compressor. The general approach to the design of this vehicle-borne system was to add the redundancy removal capability to an existing PCM telemetry system. Detailed performance capabilities and characteristics are given, and include data on inputs, outputs, data acceptance methods, programmable control logic, fixed programmed functions, memory, buffer fullness detection, and modified ZVA and FVA compression algorithm rules. Also given are operation and programming instructions, data on special test equipment, and test set-up and test results. Appendices are included for nomenclature; principles of NDRO storage; logic diagrams and schematics for the main logic assembly, test panel, and interface circuits; and interconnection wiring lists for the ZVA/FVA system breadboard and test panel. C.T.C.

N68-16382# Air Force Cambridge Research Labs., Bedford, Mass. Microwave Physics Lab.

A FAMILY OF NOVEL ANTENNAS: THE "BACKFIRE" ANTENNA

Herman W. Ehrenspeck *In* Office of Aerospace Res. Proc. of the OAR Res. Appl. Conf., 14 Mar. 1967 Mar. 1967 p 81–104 refs (See N68-16376 07-34)

The "backfire" antenna, a new antenna element that produces gains ranging from 15 to 30 dB, operates on a combination of surface-wave and open-cavity principles. Its side- and backlobes in both planes are much lower than those of conventional antennas in that gain range, and its construction is far more compact. It can be arrayed for pencil or fan beam as well as monopulse applications. Models have been tested inhouse and by NASA in the frequency range from 100 MHz to 10 GHz, with good results. The antenna is ideal for ground-to-ground and ground-to-air communications, telemetry and satellite-tracking, and lends itself to flush installation in aircraft, missiles, and space vehicles. Author

N68-16418# European Space Technology Center, Woordwijk (Netherlands).

DATA HANDLING IN IONOSPHERIC TOP-SIDE SOUNDERS

H. Marin Paris ESRO Sep. 1967 31 p refs
(ESRO-TM-99) CFSTI: HC $3.00/MF $0.65

This report deals with the acquisition, conditioning and transmission of data in ionospheric top-side sounders. Three major areas are considered. First, the nature of the physical phenomena and the scientific objectives. Second, the gathering of ionospheric intelligence by means of the back-scattering of r-f pulses. Third, the various conditioning, encoding, and modulation techniques are evaluated for their bandwidth saving and their suitability. Author (ESRO)

N68-16460*# Pennsylvania Univ., Philadelphia. Moore School of Electrical Engineering.

RADIO FREQUENCY INTERFERENCE (RFI) DESIGN GUIDE FOR AEROSPACE COMMUNICATIONS SYSTEMS

F. Haber, M. Celebiler, and C. Weil-Malherbe 25 Apr. 1967 169 p refs
(Contract NAS5-9896)
(NASA-CR-92672; Rept.-68-12) CFSTI: HC $3.00/MF $0.65 CSCL 17B

This publication has been prepared to provide guidance to designers of ground station equipment on potential electrical interference and its control for satellite tracking networks such as STADAN (space tracking and data acquisition network). Described herein are mechanisms of generations of unwanted emissions from radio transmitters, noise generation from electrical equipment not intended to radiate, susceptibility mechanisms of radio receivers, and the possible routes whereby unwanted signals can enter a receiver. The principle is described in each case, typical levels are specified where possible, reduction techniques are described, and examples are given. In addition, a brief account is given of the considerations in selecting low noise sites, and of current practice in interference measurement and instruments properties. Author

N68-16508*# New Mexico State Univ., Las Cruces. Engineering Experiment Station.

ADVANCED STUDY OF VIDEO SIGNAL PROCESSING IN LOW SIGNAL TO NOISE ENVIRONMENTS Semiannual Progress Report, 1967–1968

Frank Carden, William Osborne, and George Davis 1968 95 p refs
(Grant NGR-32-003-037)
(NASA-CR-93149) CFSTI: HC $3.00/MF $0.65 CSCL 17B

A mathematical model for the composite video signal is developed and the results are used to analyze the Apollo TV spectrum. A computer model is developed to generate the spectral components. To use the digital program the brightness function B(xy) must be specified by a 300 by 300 matrix. The computer program converts the spatial brightness function B(xy) into a composite temporal function $V^1(t)$ and gives the spectral components of $V^1(t)$. The spectral analysis showed the computed spectrum in close agreement with the measured spectrum. Further, for the TV pattern investigated the significant spectral components were well below 500 KC; in fact, the components were below the 409 KC sync burst. Rice's noise model for Gaussian modulation is modified to represent one mode of operation in the Apollo FM television system and the resulting integrals are solved digitally. A family of threshold curves are plotted with the IF bandwidth the running parameter. Author

N68-16524# Joint Publications Research Service, Washington, D. C.

RADIO-CYBERNETIC METHODS OF CONTROLLING NAUTICAL OBJECTS [RADIO-KIBERNETICHESKIYE METODY UPRAVLENIYA MORSKIMI OB"YEKTAMI]

K. Yu. Agranovskiy 23 Feb. 1968 175 p refs Transl. into ENGLISH from the paper "Radio Kiberneticheskiye Metody Upravleniya Morskimi Ob" Yektami" Leningrad, Sudostr., 1967 p 34–363

(JPRS-44470) CFSTI: HC$3.00/MF$0.65

Basic principles of constructing radio–cybernetic systems are delineated, with emphasis focused on the comparatively simple short range systems. Some consideration is also given to direction-finding and range-finding systems. Block diagrams depict the basic types of receiving element units, the analysis units included in motion control systems, the actuating unit circuitry, and the control system circuitry. The special features and operational problems associated with each are described. Equations are derived to determine the signals in direction-finding and range-finding systems, and information parameters of the control signals are defined. Basic noise characteristics are categorized and discussed from the viewpoint of the noise structure. Solutions are proposed to the problem of signal control detection. The noiseproof characteristics of a control system are considered, and it is demonstrated that these features are defined by the nature of the control signal and noise effects. The theory of potential noiseproofness is applied to show how this characteristic can be increased within certain limits. M.G.J.

N68-16558 Royal Military Coll. of Science, Shrivenham (England). Electronics Branch.

APERTURE COUPLING IN SURFACE WAVE ANTENNAS

J. R. James Feb. 1967 22 p refs

(TN-RT-33)

Aperture coupling in a cylindrical dielectric rod antenna is considered in detail and theoretical curves derived which show that the coupling increases with rod diameter and decreases with aperture separation. The effect of this in practice is investigated and in typical rod antennas it results in a small amount of phase and amplitude perturbations in the apertures. In very thick rods mode pulling is also evident and the radiation pattern is very sensitive to the rod dimensions. Useful applications of this are suggested and some experiments are performed on a dielectric filled horn. Coupling in surface wave antennas in general is briefly discussed and also the difficulty of distinguishing between coupling and lens effects in thick short rods. Author

N68-16560# Weapons Research Establishment, Salisbury (Australia).

THE GROUND CLUTTER SIGNAL AT THE INPUT OF A RADAR RECEIVER

J. A. F. Highfield Aug. 1967 23 p ref

(WRE-TN-SAD-182) CFSTI: HC$3.00/MF$0.65

By considering the ground, illuminated by elliptically polarised radiation, as a large number of small oscillating electric charges, the theoretical probability distribution of the ground clutter signal at the input of a radar receiver is derived in terms of ground parameters, transmitter–receiver geometry, and aerial polar diagrams. This paper has been written to provide a theoretical basis for a clutter model to be described in a subsequent paper. Author

N68-16583*# Melpar, Inc., Falls Church, Va.

THIN-FILM PERSONAL COMMUNICATIONS AND TELEMETRY SYSTEM (TFPCTS), PHASE C Quarterly Report, Jun. 24–Sep. 24, 1967

Oct. 1967 13 p (Contract NAS9-3924)

(Contract NAS9-3924)

(NASA-CR-65938; QR-2) CFSTI: HC$3.00/MF$0.65 CSCL 09F

The design of the voice operated switch (VOX) circuit is outlined, and a schematic is included. The purpose of the circuit is to turn the transmitter off except when the operator is talking; a signal from the audio amplifier is used to trigger the VOX to the on condition. Problems encountered in fabricating the IF module are discussed, with the failures identified as due to poor bonds or chromium capacitor plates. M.G.J.

N68-16592# Weapons Research Establishment, Salisbury (Australia).

MEASUREMENT CAPABILITIES OF THE S.R.I. DUAL FREQUENCY VHF RADAR IN RADIOPHYSICS RESEARCH APPLICATIONS

L. B. Soden Jul. 1966 11 p refs

(WRE-TM-PAD-223) CFSTI: HC$3.00/MF$0.65

The radar is described, together with observations of solar and galactic noise, moon echoes, ground back-scatter via ionospheric reflection and echoes from the satellite Echo II. These observations were incidental to the main re-entry physics measurement task of the radar. The capabilities of the radar for measurements aiding studies of the cislunar medium and the upper ionosphere are examined theoretically. Mention is made of its capabilities for useful measurement in the fields of meteor research, auroral research, and tropospheric and ionospheric propagation research. Author

N68-16608# New Zealand, Dept. of Scientific and Industrial Research, Wellington. Physics and Engineering Lab.

IYA FREQUENCY STABILIZATION

V. B. Gerard Aug. 1967 5 p ref

(R-332) CFSTI: HC$3.00/MF$0.65

A highly stable crystal oscillator and frequency synthesizer were installed on an experimental basis to control the carrier frequency of radio station IYA. During daylight hours the ground wave at P.E.L., Lower Hutt, was sufficiently strong to monitor the frequency against the New Zealand standard. Successive hourly means agreed within $\pm 1.1 \times 10^{-10}$ Author (ESRO)

N68-16659# National Physical Lab., New Delhi (India). Radio Propagation Unit.

TIME LAG IN OCCURRENCE OF Q-T POINT ON FARADAY ROTATION RECORDS AT WIDELY SPACED FREQUENCIES

Tuhi Ram Tyagi and V. P. Bhatnagar 15 Oct. 1967 15 p refs

(RPU-S-38)

An explanation of the non-occurrence of the Q-T points simultaneously on the Faraday rotation records of the two widely spaced frequencies, has been given in terms of the refraction theory. It is found with some simplified assumptions, that the time delay in Q-T points at the two frequencies f_1 and f_2 ($f_1 > f_2$) is proportional to $(M_1 - M_2/M_1M_2)$. M_1 and M_2 being the refractive indices for f_1 and f_2 respectively. The theory explains the observed time difference between the two Q-T points reasonably well. Author

N68-16688# Weapons Research Establishment, Salisbury (Australia).

THE ATTENUATION OF HF RADIO WAVES IN THE IONOSPHERE

P. L. George Jul. 1967 31 p refs

(WRE-TN-CPD(T)-137) CFSTI: HC$3.00/MF$0.65

The attenuation of h.f. radio waves propagated at oblique incidence via the ionosphere is considered, the earth/ionosphere system being treated as spherical with no imposed magnetic field. An electron density/height model consisting of parabolic and linear segments is employed to determine the oblique ray path. A model of collision frequency as a function of height is introduced and the manner in which it may be used to compute the ionospheric absorption over the path is presented. Some results of a digital computer program written to perform the necessary computations are given. Author

N68-16707*# Aerojet-General Corp., El Monte, Calif. Space Div.
MICROWAVE RADIOMETER DESIGN AND DEVELOPMENT, VOLUME 2 Final Report
C. U. Falco and G. Oister 15 Nov. 1967 349 p refs
(Contract NAS5-9680)
(NASA-CR-92669) CFSTI: HC $3.00/MF $0.65 CSCL 09F

This appendix describes the electronic components, circuitry, antenna radiation patterns, and breadboard model testing procedures for a microwave radiometer designed for use on the Nimbus meteorological satellite. E.J.S.

N68-16757# Naval Research Lab., Washington, D. C.
GEMINI EXPERIMENT D-14 UHF–VHF POLARIZATION MEASUREMENTS Final Report
R. E. Ellis, J. M. Goodman, and W. Sievers 20 Oct. 1967 44 p refs
(NRL-6591; AD-663111)

A vhf-uhf Faraday rotation experiment (D-14) was conducted in conjunction with six Gemini IX spacecraft transits over Kauai, Hawaii, and Antigua, British West Indies, on June 4, 1966. The rotational ambiguity at vhf was resolved by inspecting the received uhf polarization. The electron content and its inhomogeneities below the spacecraft have been determined. By comparing the results of the data analysis corresponding to four closely spaced transits of Gemini IX over Hawaii, a measure of the prenoon electron-content variation was obtained. Assuming a Chapman distribution and equilibrium conditions, the lower ionospheric temperature has been estimated to be approximately 1000 at midday. It has been found that the smaller ionospheric inhomogeneities (approximately 10 to 30 km) occur in greater numbers than would be anticipated strictly on the basis of their size and sample-time considerations. The irregularity excursion delta C is found to be roughly an increasing function of irregularity scale delta L, with the percentage excursion Sub delta sub c increasing between 1% and 5% per 100 km. Author (TAB)

N68-16771# Deutsche Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Inst. fuer Flugfunk und Mikrowellen.
MARITIME AND AERONAUTICAL RADAR. PHYSICAL AND TECHNOLOGICAL PROPERTIES WITH REGARD TO FREQUENCY WITHIN THE BAND 3 CM TO 8 MM [RADARANLAGEN IN SEE- UND LUFTFAHRT. FREQUENZ-BEDINGTE PHYSIKALISCHE UND TECHNISCHE EIGEN-SCHAFTEN UNTER BESONDERER BERUECKSICHTIGUNG DES WELLENBEREICHES ZWISCHEN 3 CM UND 8 MM]
W. Reinhardt Dec. 1967 267 p refs In GERMAN; ENGLISH summary
(DLR-FB-67-81)

The literature published during the last ten years about radar working on wavelengths between 3 cm and 0.86 cm has been critically evaluated. The maximum range in free space is determined in terms of radar and target parameters (radar equation). It is discussed how the various meteorological phenomena and the properties of the earth's surface influence the prediction of radar range, especially at frequencies above X-band. The developments of semiconductor technology and transmitter power generation give the specific qualities for the concurrent use of X-, Q- and K-band radars in the various services of marine, aeronautics and meteorology (cf. survey of radar equipment data). Deductions and indications are given for further practical experiments in the exploration of radar. This task is performed with regard to the interchange of ideas by industrial specialists and users of radar. Author

N68-16798# Queens Univ., Kingston (Ontario). Dept. of Electrical Engineering.
A STUDY OF THE POWER SPECTRUM OF THE OUTPUT OF A NONLINEAR ANGLE MODULATOR
A. M. Adams and F. E. Smith Aug. 1966 118 p refs
(Contract DRB/513003)
(RR-66-2)

The autocorrelation functions and power spectra for some interesting classes of randomly angle-modulated oscillators, which possess tuning characteristics with a simple nonlinearity, are calculated and plotted. A linear plus square-law modulator characteristic is assumed for the simple nonlinearity and the input is assumed to be RC-filtered Gaussian white noise. The two forms of angle-modulation considered are phase and frequency modulation. For phase modulation, the output autocorrelation function is an explicit function of the input autocorrelation function and a numerical integration method is used to obtain the output power spectrum. For frequency modulation the solution of a nonhomogeneous integral equation and the determination of a product of the eigenvalues of a homogeneous integral equation are necessary prior to the application of numerical integration techniques for obtaining the output power spectrum. The kernel of the two integral equations is the autocorrelation function of the modulating signal. Author

N68-16928# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.
RESONANCES IN PHASED-ARRAY ANTENNAS
A. Hessel, G. H. Knittel, and A. A. Oliner *In its* Microwave Res. Inst. Programs Nov. 1967 p 1–6 refs (See N68-16926 07-10)
(Grant NSF GU-1557)

Complete reflection of the incident power in phased array antennas at beam scan angles smaller than those that produce an endfire grating lobe is analyzed to determine the nature of this phenomenon. It is shown that the phenomenon occurs basically because the physical region in the neighborhood of the array face is capable of supporting two propagation modes while the air region beyond contains only a single propagation mode. Analysis of a structure containing a dielectric layer placed over a slot array showed that perfect reflection was obtained when the extra mode in the dielectric experienced the resonance effect of Wood's anomalies on optical reflection gratings. Thus, the guiding resonance is identified as a leaky wave. G.G.

N68-16929# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.
A GENERALIZATION OF FLOQUET'S THEOREM FOR CERTAIN CLASSES OF PERIOD STRUCTURES
A. Hessel, R. C. M. Li, and A. A. Oliner *In its* Microwave Res. Inst. Programs Nov. 1967 p 6–10 (See N68-16927 07-10)
(Contract AF 19(628)-4324)

Considered are two types of symmetry that relax the restrictions on simple periodic antenna structures, increase their resolution, and relate the fields separated by distances of some fraction of a period. Such space group elements are: (1) the glide symmetry consisting of a reflection in a so-called glide plane followed by a translation in a given direction, (2) them-fold screw symmetry which combines a rotation of the radians about a screw axis with directional translation along that axis, and (3) the inversion translation symmetry that combines an inversion about some origin with a displacement by some fraction of a period. G.G.

N68-16930# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.
RESONANCE EFFECTS IN SCATTERING BY CORRUGATED STRUCTURES
A Hessel and D. Tseng *In its* Microwave Res. Inst. Programs Nov. 1967 p 10–17 refs (See N68-16927 07-10)
(Contract AF 19(628)-4324)

The influence of free resonances from gratings on plane-wave scattering was analyzed by forming a simple model for the periodically modulated surface reactance plane. Time-harmonic TM and TE fields diffracted from the corrugated structure were obtained

with a rigorous solution for the plate-air interface, and expressions for TM or TE plane wave reflection and transmission coefficients were formed from a semi-infinite stack of zero thickness, periodically spaced parallel plates. A scattering coefficient matrix gave the reflection coefficients for the entire corrugated steel structure via network representation. It was concluded that Wood anomalies are determined by the location of the complex roots of the dispersion relation of the corrugated structure. The study found also an anomal resonance for the case of two spectral orders when the reflection coefficient for the n=0 spectral order goes to zero. G.G.

N68-16932# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.

RADIATION FROM AN OPEN-ENDED WAVEGUIDE

L. B. Felsen and H. Y. Yee *In its* Microwave Res. Inst. Programs Nov. 1967 p 21–29 refs (See N68-16927 07-10)
(Contract AF 19(628)-2357)

Radiation coefficients for a flanged semi-infinite parallel plane waveguide are determined by using ray-optical methods. An open ended multimode waveguide model is extended by replacing the diffraction coefficient for a half-plane by that of a wedge. The waveguide is thus regarded as compromising two parallel wedges and the radiated field is the sum of the diffracted fields from these two wedges which are illuminated by the incident field. Little distortion in the symmetry of the pattern is seen if the non-symmetric waveguide is excited by a TE_{01} mode; a non-symmetric pattern is observed with a TM_{01} incident mode. G.G.

N68-16933# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.

FREQUENCY DEPENDENCE OF CAUSTICS IN NONUNIFORM WAVEGUIDES

L. B. Felsen and S. Maurer *In its* Microwave Res. Inst. Programs Nov. 1967 p 29–36 refs (See N68-16927 07-10)
(Contract AF 19(628)-2357)

Developed is the relation between caustics and modal frequency dependence in a class of homogeneously filled nonuniform waveguides having circular, elliptic, parabolic, and hyperbolic boundaries by solving the eiconal equation for generalized orthogonal separable coordinates. A cutoff condition occurs initially in nonuniform waveguides at the narrowest section with rays perpendicular on waveguide walls. A further decrease in frequency shifts the caustics to the orthogonal set of coordinates and the cutoff region extends to wider sections of the guide with decreasing frequency. G.G.

N68-16934# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.

RESONANT SCATTERING BY HIGH-Σ DIELECTRIC SPHERES

J. Ruddy and J. W. E. Griemsmann *In its* Microwave Res. Inst. Programs Nov. 1967 p 37–39 ref (See N68-16927 07-10)

An approximation procedure for determining plane wave scattering cross section or extinction curve on high dielectric spheres in free space was developed for the resonance region. Approximate resonance forms for the induced electric and magnetic dipole currents are inferred from free space results and used to calculate the reflection coefficients for a lossless dielectric sphere in a rectangular waveguide. Equivalent circuits are used to predict the frequency behavior, energy storage, and dissipation properties of this sphere in the neighborhood of the first two resonances. Sample calculations are presented in graphical form and show good agreement with measurements of the magnitude and phase of reflection coefficient in the vicinity of the first two resonances. G.G.

N68-16975# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.

EXTREMAL STATISTICS IN COMPUTER SIMULATION OF DIGITAL COMMUNICATION SYSTEMS

M. Schwartz and S. Richman *In its* Microwave Res. Inst. Programs Nov. 1967 p 176–180 refs (See N68-16927 07-10)
(Grant NSF GK-527)

The application of extremal statistics to more efficient estimation of low error probabilities in communication system simulation is discussed. An asymptotic equation is formed for calculating the probability of exceeding a specific value or threshold by maxima or minima of random variables. The Gaussian, Rayleigh, exponential, and Laplacian distributions are among examples of asymptotically exponential distributions and may be approximated by this equation. Started was a computer simulation of various types of feedback communication systems in which nonlinear and repetitive operations on signals and noise convert simple input statistics into much more complex forms by iterating initial estimates several times using the maximum likelihood equations. G.G.

N68-16976# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.

SEQUENTIAL DETECTION FOR FEEDBACK COMMUNICATIONS

M. Hecht and M. Schwartz *In its* Microwave Res. Inst. Programs Nov. 1967 p 180–182 ref (See N68-16927 07-10)
(Grant NSF GK-527)

M-ary sequential tests have been analyzed for classes of signals which can be represented in one or two dimensions. The sequential test for AM signals consists of a fixed sample test of certain length followed by a binary sequential test on the two most likely signals. The binary sequential test incorporates data from the fixed sample tests. Two independent binary sequential tests are used to determine 4 phase signals. In all cases the average sample size is found as a function of the error. G.G.

N68-16977*# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.

CYCLE SLIPPING IN FIRST ORDER PHASE LOCKED LOOPS

D. T. Hess *In its* Microwave Res. Inst. Programs Nov. 1967 p 182–184 ref (See N68-16927 07-10)
(Grant NGR-33-006-020) CSCL 17B

Proposed is a dynamic model for a carrier plus narrow band noise that yields the expected number of cycle slipping events per second when applied to a first order phase locked loop. The phase locked loop looses "lock" during the occurrence of a large number of input steps by characterizing the steps in such a way that a gaussian shaped pulse appears during step while prior to the step the loop is assumed to be tracking exactly. With the aid of the model for the input carrier plus noise the number of steps skipped by the loop can be calculated. G.G.

N68-16978*# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.

CYCLE SLIPPING IN A SECOND ORDER PHASE LOCKED LOOP

D. T. Hess and B. Schwartz *In its* Microwave Res. Inst. Programs Nov. 1967 p 185–194 ref (See N68-16927 07-10)
(Grant NGR-33-006-020) CSCL 17B

Theoretical studies on the cycle slipping performance of a second order phased locked loop are reported. Calculations on the expected number of output clicks for a second order loop used an equivalent first order PLL bandwidth to predict the performance of the second order loop. The prediction is done by simple graphical construction once the loop parameters are known. Experimental verification was obtained for several second order loop hold-in-ranges and carrier to noise ratios. G.G.

N68-16979*# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.

WIDEBAND FM GENERATION

D. T. Hess and K. K. Clarke *In its* Microwave Res. Inst. Programs Nov. 1967 p 195–200 refs (See N68-16927 07-10)

(Grant NGR-33-006-020) CSCL 17B

It is shown that an FM wave may be generated through nonlinear shaping of an FM triangular wave by defining the equation for the triangular wave and by physically generating the wave through solid state circuits. Hot carrier diodes are used in a 12 diode sine wave generating network to reduce diode frequency effects to a minimum and to obtain a center frequency variable in the range of 200 KHz to 2 MHz. Over this range, the harmonics of the carrier are suppressed by more than 46 dB; attempts to provide accurate measurements of the generators FM distortion were not successful. Outside and inside illustrations of this generator are shown. G.G.

N68-16980*# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.

PB WATER TANK CHANNEL SIMULATOR

M. Unkauf and K. K. Clarke *In its* Microwave Res. Inst. Programs Nov. 1967 p 201–213 refs (See N68-16927 07-10)

(Grants NGR-33-006-020; NSF GK-527) CSCL 09F

Developed was a water tank random channel simulator that operates at a center frequency of 4 MHz and uses a 2.1×10^5 wave length compression between radio waves in air and sound waves in water to achieve directional antennas, small volumes, and multiple wavelength systems. Arrays of rods are used as scatterers and anti-reflection padding in the tank minimizes stray reflections and stray direct transmissions. Average pulse dispersion versus delay measurements are made with sliding circuitry that measures the average time spent at each delay. G.G.

N68-16981*# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.

THE FREQUENCY LOCKED LOOP

M. Unkauf, N. Tepedelenlioglu, and K. K. Clarke *In its* Microwave Res. Inst. Programs Nov. 1967 p 213–219 ref (See N68-16927 07-10)

(Grants NGR-33-006-020; NSF GK-527) CSCL 09F

Experimental and theoretical work on the frequency locked loop showed that the FLL provides a limiting case for the older FM with feedback circuitry. A refined method for calculating both "click" and "gaussian-like" noise outputs from the FLL was used to obtain the total noise output from a FLL as well as computations on several noise components. Investigations on a loop as threshold extension device for receiving both noisy and fading FM signals proved that the loop reduced spike-like disturbances from noise or from multipath FM signal interactions. G.G.

N68-16982# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.

SYNCHRONOUS BINARY MULTIPLEX SYSTEMS

L. Schiff and J. K. Wolf *In its* Microwave Res. Inst. Programs Nov. 1967 p 219–220 (See N68-16927 07-10)

(Contract AF 49(638)-1600)

A synchronous binary multiplex communication system is considered whereby every T seconds the transmitter emits the linear sum of m bi-phase modulated sub carriers $s_i(t)$. The power in each $s_i(t)$ is constrained to be less than some fixed constant. The channel is assumed to have a bandwidth $W = n/2T$ and to add Gaussian white noise to the transmitted signal. The performance of two receiver structures are analyzed in detail. The first receiver structure independently demodulates the m binary messages using m matched filters. If $\gamma \equiv (m/n) \leq 1$, orthogonal sub-carriers result in an error probability which goes to zero exponentially with n. A second receiver, that yields a minimum probability of error on the joint decision of the m binary digits is analyzed. By a random coding bound it is shown that for any γ, a set of $s_i(t)$ exists such that the probability of error approaches zero, exponentially with n. The reliability is calculated and is shown to be close to the reliability for the orthogonal case. Author

N68-16983# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.

ON THE SYNTHESIS OF TWO-DIMENSIONAL ARRAYS WITH DESIRABLE CORRELATION PROPERTIES

D. Calabro and J. K. Wolf *In its* Microwave Res. Inst. Programs Nov. 1967 p 220 (See N68-16927 07-10)

(Contract AF 49(638)-1600)

This study considered the synthesis of two-dimensional, periodic, binary and nonbinary sequences (arrays) which exhibit similar properties for their two-dimensional autocorrelation functions. Various procedures were considered for the synthesis of such arrays. Two perfect binary arrays and an infinite class of perfect nonbinary arrays were found. A class of binary arrays was studied which are the two-dimensional analogue of the quadratic residue sequences and have been shown to have out-of-phase autocorrelation of -1 or to alternate between $+1$ and -3. The perfect maps of Gordon have been shown to have all values of out-of-phase autocorrelation equal to -1. Other methods of constructing arrays based upon good one-dimensional sequences were also considered. Synthesis procedures were found for constructing pairs of arrays such that their cross-correlation is identically zero for all shifts and in additon individually have good autocorrelation functions. Author

N68-16984*# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.

SINGLE CHANNEL AND TRANSMITTED REFERENCE SYSTEMS

D. L. Schilling, H. Taub, J. Oberst, and P. Osborne *In its* Microwave Res. Inst. Programs Nov. 1967 p 220–226 (See N68-16927 07-10)

(Grant NGR-33-006-020) CSCL 17B

Phase shift keying systems that operate with a noisy reference signal were analyzed for performance optimization under transmitted reference (TR) mode or signal channel (SC) mode operation. A noise model was used to show that TR systems can be better than SC systems if a reference is obtained over a large enough number of bits. Results found that an SC system is superior when the number of reference bits (q) is 1 and 2, and that the TR system is superior as q approaches infinity. Applications of the most likely noise probability statistics of additive noise to a first order phased locked loop system (PLL) yielded bounds to the expected number of clicks occurring per second at a specific carrier noise ratio. G.G.

N68-16985*# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.

A RECURSIVE APPROACH TO SIGNAL DETECTION

R. L. Pickholtz and R. R. Boorstyn *In its* Microwave Res. Inst. Programs Nov. 1967 p 227–230 (See N68-16927 07-10)

(Grant NGR-33-006-020) CSCL 17B

The classical problem of detecting known signals in additive, non-white noise is treated by recursive approach under the assumption that one of two completely known signals is received in additive, zero-mean Gaussian noise. A difference equation for the likelihood ratio is formed that describes the optimum detector for deciding between the two signals in the presence of the noise. The noise is considered as being generated by a system characterized in a linear time-varying differential equation driven in turn by white stationary noise. For analog processing, the likelihood ratio is derived in a compact and general form usable for both stationary and non-stationary statistics. G.G.

N68-16986# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.

OPTIMUM ERGODIC CODES

B. Rudner and A. E. Laemmel *In its* Microwave Res. Inst. Programs Nov. 1967 p 230–235 (See N68-16927 07-10)

(Contract DA-31-124-ARO(D)-380)

The construction of ergodic codes which are optimum in two senses is developed and their application to compression coding is discussed. Assumed is a finite set of message words occuring independently with generally unequal probabilities. The index number of the code is defined as a sequence of decimal numbers and tree graph representation is used to represent the code words. A signal which resets any state, will, when traced on the tree graph starting at the node corresponding to the state, end in a terminal node. A procedure is described for constructing a 1-code by terminating the longest nodes in each column and thus leads to a code with the shortest possible minimum reset signal for a given set of code word lengths. G.G.

N68-16995# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.

VISUAL TO AUDIO TRANSLATION OF TWO-DIMENSIONAL PATTERNS

S. Deutsch and L. M. Orloff *In its* Microwave Res. Inst. Programs Nov. 1967 p 265–268 ref (See N68-16927 07-10)

(Grant NSF GK-710)

A multidimensional set of sound patterns for visual to audio translation was formed from perception studies on: multidimensional audio codes, the ability of the audio sense, and of the information capacity of the human to an audio input. Non-linear functions are used to form an effective code for two-dimensional pattern characteristics for a 30,000 word vocabulary where the content of a word requires about 30 bits of information to reproduce a printed letter. This means a total information content of 150 bits per word. A set of easily distinguishable sounds were formed and a small breadboard model device was built that performed the functions of recognizing the separate geometrical characteristics of the input patterns and of producing the audio output. G.G.

N68-17010*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

A PHASE LOCK SERVO SYSTEM

Raymond J. Stattel and John W. Fennel, Jr. Dec. 1967 59 p refs

(NASA-TM-X-63097; X-721-67-625) CFSTI: HC $3.00/MF $0.65 CSCL 09F

The concept and basic considerations for the design of a phase-lock servo system are presented. The servo system is for use in ground stations which decode pulse-position modulation (PPM) signals from sounding rockets. The theoretical concept for a system, capable of producing clock pulses which remain in phase-lock with a signal transmitted from the rocket-borne telemeter, is presented and analyzed on the basis of the three definitive modes of deviation of the airborne clock. A mathematical model for the concept is then presented and the constants for a physical system are applied to the model. Verification of the physical system by means of laboratory tests, first in terms of transient performance and then in terms of steady-state performance is next presented. Comparative conformity of performance between the theoretical concept, calculated values from the mathematical model, and laboratory tests gives weight to the feasibility of the design. Author

N68-17042*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

THE TECHNOLOGICAL PROBLEMS OF TELEVISION BROADCAST SATELLITES

Perry W. Kuhns Washington 1968 15 p refs To be presented at the Aviation and Space Conf. Sponsored by ASME, Los Angeles, 16–19 Jun. 1968

(NASA-TM-X-52385) CFSTI: HC $3.00/MF $0.65 CSCL 17B

A television broadcast service is one in which the transmission is intended for direct reception by the general public. Because of the intention of direct reception, there are technological and cost trade-offs between the receiver on the ground and the transmitter in space. In this paper, the technological level of both the ground receiver and the space transmitter are assessed. The technological problems of the spacecraft subsystems whose characteristics are determined from the trade-offs are discussed. These subsystems include: transmitting antenna, output power amplifier, power conditioning, prime power source, and attitude control and station keeping. Author

N68-17090*# General Dynamics/Convair, San Diego, Calif.

GRAVITY GRADIENT BOOM AND ANTENNA MATERIAL STUDY Final Report

H. R. Wiant 18 Aug. 1967 196 p ref

(Contract NAS5-9597)

(NASA-CR-92680; GD/C-ZZL-67-010) CFSTI: HC $3.00/MF $0.65 CSCL 09F

The study was conducted in three phases consisting of (1) the development of woven screen rigidizing procedures, (2) the generation of a mathematical model to predict thermal deflection of uncoated screen materials, and (3) a limited testing and evaluation program to verify the mechanical properties of rigidized screens. Three elgiloy–copper beryllium screens having different percent open-areas were rigidized by brazing and formed into 45-foot booms. A theoretical thermodynamic analysis of the screen-type boom was conducted and used as a basis for the practical application. An engineering prototype deployment mechanism was designed, fabricated, and tested. The wire screen boom concept proved to be a highly practical approach to the development of a low thermal distortion boom for space application. The complex nature of a rigidized, woven, dual material screen boom precluded analytical stress analysis, but selected physical parameters produced booms well within the envelope of usability. The thermal analysis of uncoated wire screen booms was used as a basis for final fabrications. The entire analysis and computer program is presented in full detail. The testing phase, although limited in extent, showed the wire screen boom to be uniform and reliable. The basic design was developed as potential space hardware. Author

N68-17170*# Melpar, Inc., Falls Church, Va.

THIN-FILM PERSONAL COMMUNICATIONS AND TELEMETRY SYSTEM (TFPCTS), PHASE C Quarterly Report, Sep. 24–Dec. 24, 1967

Jan. 1968 33 p ref

(Contract NAS9-3924)

(NASA-CR-65937; QR-3) CFSTI: HC $3.00/MF $0.65 CSCL 09F

Emphasis is placed on solving problems associated with the assembly and development of the radio frequency portions of the transmitter and receiver. The problems resulted from component failure during assembly and from dissimilarities between the thin film circuits and the conventional circuits contained in the breadboard models. The thin film modules have insufficient voltage gain, and this is believed to result from improper impedance matching between stages at radio frequencies. Areas given detailed consideration include bonding techniques, circuit assembly procedures, transistor chip preparation, circuit deposition, redesign of the transmit–receive diplexer, dc power supplies, and final package design. C.T.C.

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N68-16206*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
COMPUTER GRAPHICS, VOLUME 1 Final Report, Jun. 29–Dec. 28, 1967
28 Dec. 1967 407 p refs
(Contract NAS8-21227)
(NASA-CR-61523; LMSC-680181, V. 1) CFSTI: HC $3.00/MF $0.65 CSCL 09B

Numerical control, electrical network analysis, flight mechanics, structural analysis, and engineering drawing retrieval applications of computer graphics are presented along with a statement of user requirements for each of these applications. A study of man–machine solution optimization is discussed in terms of a complementary relationship consisting of a basic chain in which the man makes decisions which determine succeeding computer operations. A 144 curve fit program was used in which a comparison could be made between the performance of the man and the computer and, on the basis of this experiment suggestions for a more efficient division of labor between man and computer have been included. A hardware comparison is made between the CDC 273 and the Univac Mariner display generating schemes and an assumed hardware configuration is depicted. A glossary of computer and display terms is included. E. J. S.

N68-16238*# Bellcomm, Inc., Washington, D. C.
AUTODIAGRAM VERSION FOR UNIVAC 1108
G. I. Hain 15 Dec. 1967 14 p refs
(Contract NASw-417)
(NASA-CR-92808) CFSTI: HC $3.00/MF $0.65 CSCL 09B

The flow charting program Autodiagram is now running on the Univac 1108. Autodiagram draws flow charts directly from Fortran source code, and/or Univac assembly language source code, and/or PERT or PERT-like data cards. This memorandum describes the features of Autodiagram available in the Univac 1108 version, and gives examples for typical run setups. Author

N68-16245# Oak Ridge National Lab., Tenn.
REMOVAL OF CONSTANT TERMS FROM DO LOOPS
J. G. Sullivan 25 Oct. 1967 49 p
(Contract W-7405-ENG-26)
(ORNL-TM-2007) CFSTI: HC $3.00/MF $0.65

Techniques are described which can cause significant decreases in the execution time of Fortran programs. Examples are given which illustrate the techniques. Author (NSA)

N68-16257# Stanford Univ., Calif. Dept. of Computer Science.
THREE HUNDRED SIXTY (360) O. S. FORTRAN 4 FREE FIELD INPUT/OUTPUT SUBROUTINE PACKAGE
R. W. Doran Oct. 1967 22 p
(Contract F19628-C-0035)
(CS-79; AD-663884)

Programmers dealing with aspects of natural language processing have a difficult task in choosing a computer language which enables them to program easily, produce efficient code and accept as data freely written sentences with words of arbitrary length. List processing languages such as LISP are reasonably easy to program in but do not execute very quickly. Other, formula oriented, languages like FORTRAN are not provided with free field input. The Computational Linguistics group at Stanford University Computer Science Department is writing a system for testing transformational grammars. As these grammars are generally large and complicated it is important to make the system as efficient as possible; therefore, the group is using FORTRAN IV (O.S. on IBM 360-65) as the language. The group has developed a subroutine package which is described in the hope that it will be useful to others embarking on natural language tasks. The package consists of two main programs, free field reader, free field writer, with a number of utility routines and constant COMMON blocks. TAB

N68-16352*# Pittsburgh Univ., Pa. Dept. of Industrial Engineering.
A GENERALIZED MATERIAL HANDLING SIMULATION SYSTEM
Charles Edmond Donaghey, Jr (Ph.D. Thesis) 8 Feb. 1968 135 p refs
(Grants NsG-416; NSF G-11309)
(NASA-CR-93073; SRCC-69) CFSTI: HC $3.00/MF $0.65 CSCL 09B

Based on the premise that the majority of material handling systems consist of a set of moves, and a set of pieces of equipment required to execute the moves, a generalized material handling simulation system (MHSS) was developed. The computer program of the model offers a technique for describing and classifying the elements in these sets, and then a technique for simulating the interactions of these elements as the material handling system operates. Flow charts and a detailed description of the Fortran 2 program are given. Two industrial situations were used to test the validity of the MHSS model: the movement of ore to a crusher in an open pit mine, and the material handling function of fork lift trucks in a plant engaged in manufacturing atomic energy equipment. It was concluded that the results demonstrated the accuracy of the simulation program. M.G.J.

N68-16375*# Codex Corp., Watertown, Mass.
CODING SYSTEM DESIGN FOR ADVANCED SOLAR MISSIONS Interim Report
12 May 1967 89 p
(Contract NAS2-3637)
(NASA-CR-73175; IR-2) CFSTI: HC $3.00/MF $0.65 CSCL 09B

Complete documentation is presented on a core sequential decoding program for the SDS 910–920 computer. This program was previously interfaced into a complete decoding system, which was used for real time and real data simulations and demonstrations. Possible solutions are presented to the important peripheral problems of input–output and timing, synchronization, and detection of decoder errors. Some of the small general purpose computers which appear to be likely candidates for the sequential decoding application are evaluated. It is found that a machine in the 1-microsecond, $30,000 class is capable of performing a single decoder computation in about 30-microseconds, as compared to about 200-microseconds for the SDS 910–920; these figures ignore all overhead and special features of the Pioneer application. Results are presented of a detailed study on the capabilities and cost of a special purpose machine for this application. It is found that decoder computation times of about 1-microsecond can be achieved with readily available components at a total hardware materials cost under $10,000. C.T.C.

N68-16388*# Codex Corp., Watertown, Mass.
CODING SYSTEM DESIGN FOR ADVANCED SOLAR MISSIONS Final Report
20 Dec. 1967 94 p refs
(Contract NAS2-3637)
(NASA-CR-73176) CFSTI: HC $3.00/MF $0.65 CSCL 09B

It is assumed that minimizing the power required to support a given bit rate will continue to be the principal goal of the communications system designer, and that the error probability required will become lower and lower as more and more data reduction is performed onboard. Also assumed is the feasibility of coherent demodulation that implies the applicability of the ideal white gaussian noise channel model. A review is given of the fundamental causes of the decoding behavior of a general class of

decoders for convolutional codes, which includes sequential decoders as a typical subclass. New understanding is developed about the cause of the computational distribution, the character of significant noise bursts and the resulting error patterns, and the effects of finite constraint length. These results are used in the development of a point of view about concatenation schemes, and this point of view is used to develop a number of classes of different schemes and to predict the most important aspects of their computational behavior. This point of view is substantially validated by simulating a few simple concatenation schemes and comparing the observed performance with predictions. C.T.C.

N68-16399# RAND Corp., Santa Monica, Calif.
CURVE FITTING AND EDITING VIA INTERACTIVE GRAPHICS
Arthur S. Priver and Barry W. Boehm Dec. 1967 6 p refs Presented at the ACM Symp. on Interactive Systems for Exptl. Appl. Mat., Washington, D. C., 26–28 Aug. 1967
(P-3742; AD-663228)

The system described allows a user to enter a curve into an IBM 360/40 computer via a RAND Tablet, and interactively to specify various ways of fitting, editing and displaying the curve on an IBM 2250 scope. It was developed primarily as a tool to extend the analysis of multivariate function representation from tabular methods to polynomial methods. TAB

N68-16405# Lear Siegler, Inc., Grand Rapids, Mich. Instrument Div.
LORAN-C HYPERBOLIC COORDINATE CONVERTER SET (AN/AYA-4) Final Report
D. Wozniak, W. Craig, H. Feikema, and N. Harnisch Jun. 1967 119 p Prepared jointly for FAA and US Coast Guard
(Contract FA-WA-4659)
(SRDS-RD-67-31, V. 1)

Hyperbolic Coordinate Converter Navigation Computer Set capability and description are discussed. Problems encountered during lab testing and flight test are discussed. Recommendations are made concerning particular problems and how to improve the system functionally. The theoretical development of the Computer Set is discussed showing the equations, subroutines utilized, and program flow diagrams. The hardware discussion covers the components and techniques used in the Computer Set. The flight test discussion covers flight test in the East Coast and Europe. The results of the error analysis are given for the particular flight test using various sensors for navigation. Author

N68-16425# Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
ANHYSTERETIC MAGNETIZATION AND FLUX REVERSAL IN TAPE CORES, AND AN ANALOG CORE MEMORY
F. J. Friedlaender and J. D. McMillen Dec. 1967 86 p refs Sponsored in part by Army, AF and NSF
(Contract N0014-67-A-0226-0004)
(TR-EE67-20)

The low speed switching mechanism for 50% nickel–iron tape cores is investigated by several experimental procedures. These include finding the high-field response of a core partially switched by a low field, recording the partial hysteresis loop starting from a remanence established by fields of various magnitudes, and switching with low field a core which has been only partially reversed by a high field. Anhysteretic magnetization curves are obtained, and they are related to core geometry. A general summary of switching models for all ranges of switching is presented. From this, and the data it is possible to conclude a lower bound on the energy of a 180° domain wall in the tape. An analog memory device is presented and described. This is based upon the concepts of flux reversal presented in this and earlier works. Author

N68-16451*# Stanford Univ., Calif. Radioscience Lab.
ON THE TIME REQUIRED FOR GROUP MULTIPLICATION
P. M. Spira Jan. 1968 14 p
(Grant NsG-377)
(NASA-CR-92979; SU-SEL-68-003; SR-24) CFSTI: HC $3.00/MF $0.65 CSCL 09B

Consideration is given to the time required to perform group multiplication by means of networks of logical elements–each having a limited number of inputs and unit delay in computing their output function. A new lower bound is given which is, in general, higher than Winograd's but which reduces to his bound if the group of interest is Abelian. In addition, a scheme to realize multiplication in any group, Abelian or not, is given. This new circuit has computation time either equal to or one time unit greater than our lower bound. Also, if the group of interest is Abelian, it computes at least as rapidly as Winograd's network to do the same multiplication. Author

N68-16464# Union Carbide Nuclear Co., Oak Ridge, Tenn.
COUNTING SCHEMES FOR NUCLEAR DATA ACQUISITION ON SMALL COMPUTERS
Bert W. Rust and Walter R. Burrus [1967] 15 p refs Presented at the 14th Nucl. Sci. Symp., Los Angeles
(Contract W-7405-ENG-26)
(K-DP-2593; CONF-671026-4) CFSTI: HC $3.00/MF $0.65

In using a small computer for accumulating a pulse height spectrum, it is often the case that the word length is too small to store the counts on a one-word-per-channel basis. The use of double precision to avoid this problem is wasteful of storage space. One way to avoid this waste is to store the differences between counts in two adjacent channels rather than the counts themselves. Another method involves the use of a stochastic counting scheme for accumulating the spectrum. These methods are presented and discussed. Author (NSA)

N68-16523# Joint Publications Research Service, Washington, D. C.
ADAPTIVE METHODS OF ANALOG TO DIGITAL CONVERSION
A. Sovin'skiy 16 Feb. 1968 9 p refs Transl. into ENGLISH from Avtometriya (Novosibirsk), no. 4, 1967 p 90–97
(JPRS-44403) CFSTI: HC $3.00/MF $0.65

The use of adaptive digital measurements systems is proposed as an optimization technique for increasing the efficiency and economy of operation of the units by eliminating excessive information. As applied to analog-to-digital conversion methods, two procedures are discussed: (1) parametric adaptation referring only to the parameter which is the converted (measured) quantity; and (2) time adaptation referring to the time process of conversion of the quantity. Adaptive digital measurement methods are characterized as methods realized with the help of circuits that change their structure and parameters depending on the conditions or requirements with respect to the measured quantities occurring during the measurements. Devices in which the pulse-time conversion method is used are described and diagrammed. It is shown that the criterion of adaptive converters is acceptable when using the compensation method. M.G.J.

N68-16575 European Organization for Nuclear Research, Geneva (Switzerland).
A DATE-LINK BETWEEN TWO COMPUTERS: DEVELOPMENT OF SOFTWARE AND EXPERIENCE OF ITS USE WITH A MISSING-MASS SPECTROMETER EXPERIMENT
T. R. Bell, B. C. Levrat, P. J. Marcer, and E. M. Palandi 21 Dec. 1967 35 p refs
(CERN-67-31)

Data from a missing-mass spectrometer experiment, collected and prechecked on an SDS 920, was transmitted via data-link to

the CERN central computing facilities where it was processed on-line within the environment of the SIPROS multiprogramming operating system of the CDC 6600. The software developed for the initial production runs is described, together with the experience obtained. Author

N68-16580# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MATRIX COMPUTER FOR CALCULATING CORRELATION FUNCTIONS [MATRICHNOYE SCHETNO-RESHAYUSHCHEYE USTROYSTVO DLYA VYCHISLENIYA KORRELYATSIONNOY FUNKTSII]
O. V. Ulin and V. K. Petunin 28 Jul. 1967 14 p refs Transl. into ENGLISH from Akad. Nauk SSSR, Sibir. Otd. Inst. Avtomat. i Elektr. Izmereniya, v. 2, 1964 p 78–83
(FTD-HT-23-830-67; AD-662838)

A semi-automatic correlator that uses a matrix network for the multiplication operation is described. The source data in the form of a numerical table is inserted into the correlator by a keyboard device. The correlator includes a multiplication matrix designed with square-loop ferrites, transistorized block generators and amplifiers, and also ferrite-diode registers with a compensating core in each cell. A block diagram and a principal circuit of the correlator are presented, and its operation is described. The maximum relative error depends on the number of discrete levels in the multiplication matrix. The correlator speed of operation is determined by the product read time; average time of one reading is 0.1–0.15 sec. TAB

N68-16678# RAND Corp., Santa Monica, Calif.
SOVIET CYBERNETICS: RECENT NEWS ITEMS
Wade B. Holland, ed. Dec. 1967 104 p refs *Its* No. 11
(P-3600/2; AD-663229)

Contents: Brief items; All-union production classifier; Machine descriptions; Book on M-20, BESM-3M, BESM-4, M-220: table of contents; Chaos in development of management systems; New data handling devices; 1966 research summary; academies of sciences; Characteristics of several soviet computers; Press review, November 1967. TAB

N68-16704*# Stanford Univ., Calif. Radioscience Lab.
DIGITAL FILTER DESIGN TECHNIQUE AND THE REALIZATION OF TRANSFER AND IMMITTANCE FUNCTIONS BY USING DIGITAL ELEMENTS
Chia-Peir Yu Nov. 1967 96 p refs
(Grant NsG-377)
(NASA-CR-92978; SU-SEL-67-085; SR-22) CFSTI: HC $3.00/MF $0.65 CSCL 09B

Realization of two kinds of network functions by using digital elements are presented; these are (1) transfer functions, including the design of digital filters and spectrum analyzers where the real time implementation is made possible by using high speed, small size, integrated digital building blocks. Methods of digital integration are discussed whereby a configuration of the digital integrator is proposed as the the basic digital element for real time device implementation. (2) Driving point impedance and admittance functions are also realizable by using digital elements provided that analog-to-digital and digital-to-analog converters are available. In both converters can be made available in integrated circuit form, then any analog components, either a single element or a combination of single elements, existing in the state of the art can be realized on a chip with digital elements. All the synthesizing works are are carried out by using Laplace transformation, except where the time varying coefficients transfer function is discussed. Author

N68-16709*# Maryland Univ., College Park. Computer Science Center.
X-RAY 67: PROGRAM SYSTEM FOR X-RAY CRYSTALLOGRAPHY
Werner C. Rheinboldt Dec. 1967 176 p refs Prepared in cooperation with Geol. Surv., and Inst. Mater. Res.
(Grant NsG-398)
(NASA-CR-93161; TR-67-58) CFSTI: HC $3.00/MF $0.65 CSCL 09B

The X-ray system of 1967 is a rewrite of X-ray-63. It consists of a set of Fortran programs all interrelated and sharing mutual data files and data card formats. The programs are structured in two main divisions. The nucleus set (which is identified by the prefix nuc) and the working diffraction calculation set (which is identified by the prefix xy). The nucleus of the system has, in actuality, nothing to do with diffraction calculations, per se, but is rather an essentially Fortran sub-system monitor which allows any other Fortran program to be integrated into its library. The coding for all the X-ray system has been done in a "neutral" Fortran 4 and Fortran 66 "Pidgen" dialect. NUC901 (nusf) is able to translate the symbolic decks to take care of any individual peculiarities of the IBM 7094, UNIVAC 1107, 1108, CDC 3600, CDC 6400, 6600, and the larger IBM 360 series. In addition to the care exercised in assuring the universality of the Fortran used, all of the local computer laboratory file numbers, page length, file commands, etc. are coded into carefully marked subroutines of the nucleus. Therefore, changes in the diffraction programs are, as far as is known from experience on a few of the above named machines, eliminated. Author

N68-16752# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INSTRUMENTS FOR DETERMINING CORRELATION FUNCTIONS
K. V. Tomingas and M. S. Alabyan 14 Jun. 1967 14 p Transl. into ENGLISH from Tekhn. Kibernetika, Akad. Nauk SSSR, Inst. Avtomat. Telemekhan. (Moscow), 1965 p 56–60
(FTD-HT-66-598; AD-663356)

A brief description is given of a new electromechanical correlator for the calculating correlation and mutual correlation functions. It was developed jointly by the Institute of Automation and Telemechanics (Institut avtomatiki i telemekhaniki) and the Tsvetmetavtomatika Design Bureau (Konstruktorskoye byuro Tsvetmetavtomatika). Two standard RU5-02 servomechanisms are used for information scanning from 160-mm wide diagram rolls. The correlation function of two stationary random processes is carried out by multiplying and integrating two electrical quantities proportional to the parameters under investigation. The integration is carried out on an integrating motoro the number of turns of which is a linear function of the applied voltage. The article presents the block diagram of the electromechanical correlator, detailed technical data, the circuit diagram of the frequency divider block, and an example of correlation function determination, which is compared with the correlation function calculated on an electronic computer. The correlator error does not exceed 15%. The calculation of 30 points of the correlation function from a 1.5-m long recording of a random process required 4 hours of work with a 3 mm/sec speed of advance. TAB

N68-16775# American Mathematical Society, Providence, R. I.
DEVELOPMENT OF COMPUTER AIDS FOR TAPE-CONTROL OF PHOTOCOMPOSING MACHINES. REPORT NO. 2: EXTENSION OF THE SYSTEM OF PREPARING A COMPUTER-PROCESSED TAPE TO INCLUDE THE SETTING OF MULTIPLE LINE EQUATIONS
Jul. 1967 49 p refs
(Grant NSF GN-533)
(PB-175939) CFSTI: HC $3.00/MF $0.65

Programming approach is considered for extending the system to prepare tape that includes the setting of multiple line equations for use in photocomposing machines; and the translator, processor, and typesetter are discussed. Input languages in general, existing languages, and the standard typesetting input language are reviewed; and languages are tested as keyboard input languages. Tests of input language as well as alternate methods of composition are considered. M.W.R.

N68-16801# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

A METHOD OF MINIMIZING MICROPROGRAMS [OB ODNOM METODE MINIMIZATSII MIKROPROGRAMM]

T. F. Slobodyanyuk 27 Jul. 1967 17 p refs Transl. into ENGLISH from Akad. Nauk Ukr. SSR. Kibernéticheskaya Tekhn. (USSR), 1965 p 72–80
(Contract AF 33(657)-16408)
(FTD-HT-23-600-67; AD-662821)

The author proposes an algorithm for minimizing individual edges, i.e., for reducing the number of microcommands which correspond to individual edges. This reduction is achieved by adding some type of coupling in the operational registers, and introducing new registers or new signals, which enables the device to use less cycles to execute an operation, which, in turn, reduces the microprogram of the operation. The construction of an algorithm is described in detail. The algorithm serves to minimize the following subprograms: (1) evolution; (2) conversion from a decimal system of notation to a binary system; and (3) conversion from a binary system to a decimal system. The results obtained during the minimization of microprograms using the algorithm discussed are tabulated. An analysis of the results shows that the application of the algorithm (a) reduced the time for the execution of the microprogram by 6–12%; (b) reduced the dimensions of the microprogram by 23–39%; and (c) for some microprograms it reduced the amount of equipment required in the operational section. TAB

N68-16884# Navy Underwater Sound Lab., New London, Conn. Data Analysis Branch.

CAPABILITIES AND APPLICATIONS OF A THIRTY-BAND DATA ANALYSIS SYSTEM

Thomas R. Finnegan and Elton P. Kelley 2 Nov. 1967 28 p refs
(USL-845; AD-663107)

The signal processing system described is capable of simultaneously processing a signal through 30 contiguous band-pass filters to determine by means of a selectable computing period (1) the maximum peak value or energy of an impulse type of signal or (2) a measure of the energy or intensity of a continuous wave type of signal. The system has a frequency range of 0 to 50,000 Hz and an input dynamic range of 60 db and generates an output in absolute values or engineering units. Its output is in a medium and format compatible with other data processing systems, such as digital computers, X-Y plotters, and optical display devices. Author (TAB)

N68-16967# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.

DIGITAL DATA TERMINAL

I. Kohavi and E. J. Smith *In its* Microwave Res. Inst. Programs Nov. 1967 p 154–160 (See N68-16927 07-10)
(Grant NSF GU-1557)

Described is the design and construction of a magnetic tape terminal for the IBM 7040 computer that produces a continuous analog signal output corresponding to digital data stored in successive blocks on the tape in a prescribed sampling rate. In the case of digital information representing music, each data sample is stored as two successive bits. The desired music sampling rate is 20 KHz; monaural as well as stereo music is accomodated and a block diagram of the system together with the state diagram and a symbolic description of the sequence of operations is shown. G.G.

N68-16971# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.

A MICROPROGRAMMED LIST PROCESSING COMPUTER

H. W. Lawson, Jr. *In its* Microwave Res. Inst. Programs Nov. 1967 p 166–168 refs (See N68-16927 07-10)
(Grant NSF GU-1557)

Design of a general purpose programming language for describing and manipulating complex data structures is based largely on the list processing facilities of the PL/I programming language. The tradiational sequential logic approach to computers is changed to read-only memories that contain microprograms which interpret the instructions and direct the operation of the hardware facilities. The microprogram is plugged into the computer on some medium such as a card capacitor that becomes the read-only memory and can only be altered by inserting a new microprogram. This approach provides emulators on current third generation computers. G.G.

N68-17018# Information Research Associates, Inc., Lexington, Mass.

AN ALGORITHM FOR NONPARAMETRIC PATTERN RECOGNITION

Ernest G. Henrichon, Jr. 17 Nov. 1967 22 p refs
(Contract Nonr-4752(00))
(TR-14; Rept.-10024; AD-663109)

An algorithm is presented for determining decision boundaries based on learning samples in a two-category pattern recognition problem. It is shown that the algorithm yields results which converge in probability to the optimal results (in the sense of minimum probability of error). A confidence bound for the probability of error is obtained. Author (TAB)

N68-17025# Pennsylvania Univ., Philadelphia. Moore School of Electrical Engineering.

MATHEMATICAL STUDIES FOR SELF-ORGANIZING SYSTEMS Final Report

Morris Rubinoff, A. Eliasoff, and G. Ingargiola Griffiss AFB, N. Y. RADC Nov. 1967 134 p refs
(Contract F30602-67-C-0007)
(RADC-TR-67-556; Rept.-68-09; AD-663239)

The final report describes progress made in studies of mathematical models for self-organizing systems. Two models have received detailed investigation. The first is an intelligent machine with specific application to logic design of witching systems, and the second is a graph model of Turing machines and the data on which they operate. The latter model has been successfully applied to the description of a self-producing universal Turing machine. The latter has been programmed on the 7040 and a simulation has been run successfully. Author (TAB)

N68-17080*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

COWELL ORBIT GENERATOR ERROR AND TIME ANALYSIS PROGRAM

G. A. Cigarski (Wolf Res. and Develop. Corp., Bladensburg, Md.) and C. E. Velez Aug. 1967 104 p refs
(NASA-TM-X-63085; X-553-67-491) CFSTI: HC $3.00/MF $0.65
CSCL 09B

A program designed to numerically integrate the equations of motion of an artificial earth satellite is described. The method used is the Cowell predictor-corrector process with a local error control which is based on a variation of order and/or stepsize during the integration. The effects of such controls on the integration are displayed in the form of a resume which includes computer timing

data, a stepsize distribution analysis, and a propagated numerical error estimate. In addition, an option to numerically integrate in multirevolution steps is described. Author

N68-17113*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
COMPUTER GRAPHICS. VOLUME 2: AN ANNOTATED BIBLIOGRAPHY TO THE NASA–MSFC DIGITAL COMPUTER GRAPHICS PROGRAM
Helen M. Abbott Dec. 1967 127 p refs
(Contract NAS8-21227)
(NASA-CR-61583; LMSC-680181, V. 2; SB-67-4) CFSTI: HC $3.00/MF $0.65 CSCL 09B

These 276 selected references were compiled as a part of the literature search effort in support of digital computer graphics. This literature provides a state-of-the-art review of the latest published literature in the area of computer graphics. Included are citations to some of the principle contributions in the literature during the period from 1960 to October 1967, including both open and government sources. The references are arranged alphabetically by personal author or title. An author, corporate source, and a subject index have been included to assist in locating specific items of interest. Author

N68-17154*# Little (Arthur D.), Inc., Cambridge, Mass.
APPLICATION OF STATISTICAL ASSOCIATION TECHNIQUES FOR THE NASA DOCUMENT COLLECTION
Paul E. Jones, Robert M. Curtice, Vincent E. Giuliano, and Murray E. Sherry Washington NASA Feb. 1968 111 p refs
(Contract NASw-1051)
(NASA-CR-1020) CFSTI: HC $3.00/MF $0.65 CSCL 05B

Computer programs for batched associative search of the NASA coordinate-indexed document collection have been prepared and tested. Cooccurrence counts for the approximately 18,000 terms used to index about 100,000 documents were obtained and association matrices based on various subsets of these counts were developed. One section of the report describes the system as a whole; the remainder is focused on a discussion of the behavior of the system observed during tests of the programs. Author

N68-17176# Lear Siegler, Inc., Grand Rapids, Mich. Instrument Div.
LORAN-C HYPERBOLIC COORDINATE CONVERTER SET (AN/AYA-4) Final Report
D. Wozniak, W. Craig, H. Feikema, and N. Harnisch Jun. 1967 132 p *Its* Publ. No. GRR-67-1314-II
(Contract FA-WA-4659)
(SRDS-RD-67-31, 2)

The theoretical and hardware developments of the Loran-C hyperbolic coordinate converter set AN/AYA-4 are described. The section on theoretical development presents the mathematical derivations of all equations implemented in the computer, a complete list of all subroutines, program logic flow charts, computer instruction listings, and a tabulation of temporary memory parameters and their locations. The hardware development section describes the interface conversion techniques, controller, indicator electronics, arithmetic unit and transfer systems, power conditioner, core rope memory, read–write memory, crystal controlled 10 megacycle clock, and timing unit. The appendix contains a Loran-C error analysis for 25 existing triads. R.N.A.

N68-17195# Weapons Research Establishment, Salisbury (Australia).
DATA REDUCTION FOR WREMARC
F. A. G. Day and P. N. McCarter Apr. 1967 56 p refs
(WRE-TN-TRD-23) CFSTI: HC $3.00/MF $0.65

A method of computing missile attitude using data from photographs is described. The method is based on the requirements for automatic data reduction and is used in the WRE 7090 programme IT 5.10.1. The WRE 7090 programme specification is included as an Appendix. Author

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N68-16121# United Aircraft Corp., Norwalk, Conn. Norden Div.
INTEGRATED ELECTRONIC VERTICAL DISPLAY RESEARCH Interim Technical Report, 1 Jul.–31 Dec. 1966
Harold C. Wooding, Jr. and John A. Simpson 24 Feb. 1967 116 p refs
(Contract Nonr-4489(00))
(Rept.-1161-R-0028; AD-657951)

The report describes the results of the initial phases of the Integrated Electronic Vertical Display (IEVD) Research Program. These initial phases are the study and analysis phases, which preface the simulation, evaluation of the simulation, and the display mechanization. The objective of the program is to originate and develop design recommendations for a universal IEVD. Such a vertical display will permit instrument flight rules (IFR) flight to a realistic set of performance criteria which are projected as being representative of military requirements for the 1970-75 time period. Typical vehicles and missions have been specified after a systematic analysis of many diverse types of aircraft and their corresponding missions. The requirements for these aircraft have been projected on the basis of the aircraft being part of the military inventory during the 1970s. Particular interest has been directed toward those craft capable of V/STOL and high speed flight in forming the generalized requirements. Author (TAB)

N68-16125# Japan Broadcasting Corp., Tokyo. Electron Tube Research Div.
A NOISELESS NEON DISCHARGE TUBE
Takeo Kamegaya Nov. 1967 19 p refs
(Rept.-114)

Noise causes and noise elimination methods were investigated in order to develop a noiseless neon discharge tube which is equal or better than conventional tubes in brightness and discharge characteristics. Paths of noise to receiver are discussed; as are noise intensity and interference in television receivers, tube design, and noise suppression. M.W.R.

N68-16148# Institut Franco-Allemand de Recherches, St. Louis (France).
THE FORMATION OF THE VACUUM ELECTRIC ARC AND ITS UTILIZATION FOR THE PRODUCTION OF X-RAY IMPULSES [LA FORMATION DE L'ARC ELECTRIQUE DANS LE VIDE ET SON UTILISATION POUR LA PRODUCTION D'IMPULSIONS DE RAYONS X]
F. Jamet 14 Dec. 1966 88 p refs In FRENCH
(ISL-9/66)

Electrical vacuum discharges to produce X ray impulses are studied and applied to improve the output of X ray flash tubes. A brief survey on electrical vacuum discharge properties and construction of X ray flash tubes is followed by measurements on X ray emission flash duration, luminescence in the discharge current, and in the discharge tube. Also reported is the construction

of vacuum discharge tubes with X ray flash impulses of only 30 ns that cover sufficient film densities 1 m from the focal point. Author

N68-16150# Institut Franco-Allemand de Recherches, St. Louis (France).
RESEARCH ON MULTIPLE X-RAY FLASH TUBES. 2: TESTS WITH A SIX-SECTION X-RAY FLASH TUBE FOR WEAK RADIATION [UNTERSUCHUNGEN UEBER MEHRFACH-ROENTGENBLITZROEHREN. 2: VERSUCHE MIT EINEM SECHSFACHROENTGENBLITZROHR FUER WEICHE STRAHLUNG]
G. Thomer and F. Jamet 31 Aug. 1966 32 p refs In GERMAN
(ISL-4/66, Pt. 2)

Described is the construction of an X ray flash cinematographic apparatus with 6 discharge channels for high speed photography. The device operates at 25 to 40 kV and produces 6 X ray flashes of about 150 ns duration at 1 ns time intervals. Impulses are triggered by relay circuit in consecutive sequence. Included are exposure series of hollow cathode discharge rays with their tip instabilities as well as the ray decomposition into single particles. Author

N68-16260# California Univ., Berkeley. Lawrence Radiation Lab.
GERMANIUM FET: A NOVEL LOW-NOISE ACTIVE DEVICE
Emanuel Elad and Michiyuki Nakamura Sep. 1967 17 p refs Presented at 14th Nucl. Sci. Symp. of the IEEE, Los Angeles, 31 Oct.–2 Nov. 1967
(Contract W-7405-ENG-48)
(UCRL-17818; CONF-671026-7) CFSTI: HC $3.00/MF $0.65

A novel device for low-noise amplification, the germanium junction field-effect transistor (JFET) is introduced. The properties of germanium and silicon at cryogenic temperatures are summarized. Based on the conclusions of this summary, a theoretical comparison between germanium and silicon JFET's is made, followed by a comparison of commercially available JFET's from both materials. A low-noise preamplifier featuring liquid-helium-cooled germanium JFET's was built and operated with semiconductor radiation detectors. Pulse generator resolution of the preamplifier for zero external capacitance is 0.28 keV fwhm (Ge) with a slope of 0.018 keV/pF. Actual resolution obtained with the silicon detector for low-energy X-rays is 0.37 keV. Author (NSA)

N68-16342*# Massachusetts Inst. of Tech., Cambridge. Particle Optics Lab.
ELECTRON MICROBEAM TESTING OF INTEGRATED CIRCUITS
C. K. Crawford Feb. 1968 31 p refs
(Contract NAS12-558)
(NASA-CR-86026; TR-2) CFSTI: HC $3.00/MF $0.65 CSCL 09A

The ever decreasing size and increasing complexity of electronic microcircuitry implies the need for new testing methods for circuits too small for the use of mechanical probes, and too complex for functional testing limited to input and output terminals. This paper considers the feasibility of various methods of using electron beams to introduce signals and sense potentials at arbitrary points in a microcircuit. These techniques, which are compatible with electron and ion beam fabrication processes, are capable of providing multiple inputs and outputs with currents close to one microampere in one micron size spots. It is shown that circuit potentials may be accurately determined using either mirror microscopy or secondary electron energy distributions. The techniques should make very large arrays of very small components practical by allowing in situ discretionary wiring to proceed concurrently with testing. Author

N68-16381# Michigan Univ., Ann Arbor. Dept. of Electrical Engineering.
COMPUTER-AIDED CIRCUIT DESIGN
Donald A. Calahan *In* Office of Aerospace Res. Proc. of the OAR Res. Appl. Conf., 14 Mar. 1967 Mar. 1967 p 69–79 refs
(See N68-16376 07-34)

The complexity of micro-electronic circuits and the attendent requirement for maximum reliability has forced the circuit designer to turn to computer aided approaches to design. Over the past four years, this investigator has been concerned with the development of computational algorithms for the analysis and design of electrical networks. The research has been concentrated particularly on methods of computer synthesis or rather arbitrary forms of linear networks. By insisting on a formal and general approach to the design of linear networks a powerful interative computer technique has been developed for solving both classical problems and network synthesis and modern problems in active networks and micro-electronics. Author

N68-16530*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECTS OF CABLE AND CIRCUIT PARAMETERS ON THE PRECISION CALIBRATION OF A CHARGE AMPLIFIER
John J. Smithrick and Ira T. Myers Washington Feb. 1968 22 p refs
(NASA-TN-D-4300) CFSTI: HC $3.00/MF $0.65 CSCL 09A

The effects of cable and circuit parameters on the precision calibration of a charge amplifier for microsecond pulses, such as those obtained from semiconductor diode particle detectors, are evaluated. The precision calibration method is described. A mercury-wetted relay pulse generator driving a 1-picofarad capacitor was used as a charge generator. The accuracy of the calibration was ±0.4 percent. Author

N68-16548*# Massachusetts Inst. of Tech., Cambridge. Electronic Systems Lab.
COMPUTER-AIDED ELECTRONIC CIRCUIT DESIGN, PART 1. THIN FILM ACTIVE DEVICE INVESTIGATIONS, PART 2 Status Report, 1 Jun.–30 Nov. 1967
Jan. 1968 35 p refs
(Grant NsG-496; MIT Proj. DSR-76152)
(NASA-CR-92929; ESL-SR-337, Pt. 1; ESL-SR-337, Pt. 2) CFSTI: HC $3.00/MF $0.65 CSCL 09A

Specific topics in on-line design include: the tearing of networks into subnetworks, for improving computational efficiency; the development of a function-algebra and network production rules for the noniterative solution of nonlinear resistive networks; progress in the CIRCAL-II on-line circuit-design program; and progress in LOTUS, an on-line program for block-diagram-system design. Research in thin-film active devices has been directed towards the structural and electrical properties of evaporated gallium arsenide films. The objective is to develop a coplanar-electrode, space-charge-limited triode. An initial structural study has used transmission electron microscopy of GaAs films evaporated on NaCl substrates over the temperature range 270°C to 550°C. Electrical measurements have been on films evaporated onto amorphous glass and quartz substrates. The effects of alloying of various metal contact films with the GaAs films have been observed. Author

N68-16606# Toulouse Univ. (France). Faculty of Sciences.
INFLUENCE OF TEMPERATURE ON THE CHARACTERISTICS OF SILICON PLANAR TRANSISTORS [INFLUENCE DE LA TEMPERATURE SUR LES CARACTERISTIQUES DES TRANSISTORS PLANAR AU SILICUM]
Paul Galy (M.S. Thesis) 5 Jan. 1965 100 p refs In FRENCH
CFSTI: HC $3.00/MF $0.65

Temperature is a very important factor determining the behavior of semi-conductor components used as deviation detectors and preamplifiers. If good use is to be made of transistors, accurate knowledge of their parameters over a wide range of temperatures is essential. This is a study of the variations of these parameters as a function of the temperature of: the 'emitter-base' voltage and its derivatives; the base current; and the dynamic gain in current

in common-emitter. The temperature range studied extends from −30 to 120°C. Measurements were made on 30 silicon planar transistors (operating at low and medium levels of collector current) by keeping the output parameters of the transistor (collector current and collector-emitter voltage) constant and measuring the input parameters (base current and emitter-base voltage). As far as possible the theoretical data have been compared with the experimental results. ESRO

N68-16621# Stanford Research Inst., Menlo Park, Calif.
RESEARCH IN MICROMINIATURIZATION USING ELECTRON-ACTIVATED MACHINING TECHNIQUES Final Report
John Kelly Dec. 1967 72 p refs
(Contract Nonr-2887(00))
(AD-663293)

The underlying theme was the development of a thin-film deposition and high-resolution micromachining technology that would ultimately permit the fabrication of data-processing systems having large numbers of suitably intercoupled active devices entirely under contaminant-free ultra-high-vacuum conditions. Only refractory metals and dielectrics would be utilized in the final structures to achieve the required degree of stability, uniformity, and operational life. Progress on the basic ultra-high-vacuum technology and ancillary instrumentation is described, including: vacuum stations designed for bakeout at 900C and capable of rapidly attaining pressures of the order of 10 to the minus 12th power torr; precision electron optical columns having resolutions of several hundred angstrom units after 900C bakeout; and compatible quadrupole mass spectrometers, continuous-dynode electron multipliers, thin film deposition sources, manipulators, and other accessories. The development of suitable electron-sensitive resists, the use of which forms the basis for achieving high resolution in thin-film micromachining, is covered and the various techniques for etching unprotected film areas are described. Applications of this thin-film technology to the formation of micron-size electron devices, now supported primarily under separate contracts, are covered briefly. This work includes the development of refractory micron-size electron tubes operating on field-emission principles and novel high-speed, high-capacity storage tubes. Author (TAB)

N68-16714# Sandia Corp., Albuquerque, N. Mex.
USER'S MANUAL FOR ACCEL SYSTEM
Clifford J. Fisk and David L. Caskey Oct. 1967 119 p refs
(Contract AT(29-1)-789)
(SC-M-67-639) CFSTI: HC $3.00/MF $0.65

ACCEL, a set of computer programs designed to aid in construction of electronic printed circuit boards is described. ACCEL has the capability to produce all the design information required by a printed circuit fabrication shop for construction of the boards. Input information is furnished by the circuit designer in the form of a circuit schematic drawing, and information on the parts used in the circuit. This information is then transcribed onto punched cards. The computer output is graphical in the form of several plots. These include a schematic drawing, a parts list, an assembly drawing showing the location of parts on the printed circuit board, a hole-drilling coordinate list, and masks to be used in etching the circuit board layers. Thus the ACCEL system performs four major tasks. First, it edits the engineers' data, resolves the schematic into a node-component list, looks up physical and electrical data for the parts used in the circuit, and notes any errors in the data. Second, it locates the components on the board by an iterative process. Third, the program lays out the interconnection pattern between the components. Fourth, ACCEL generates the output plots. The use of ACCEL can significantly reduce the time required to produce a finished printed circuit board. Author (NSA)

N68-16755 Australian National Univ., Canberra. Dept. of Engineering Physics.
SIMPLE THYRISTOR CIRCUITS TO PULSE FIRE IGNITRONS FOR CAPACITOR DISCHARGE
C. F. Vance Mar. 1967 13 p refs
(EP-RR-16)

Simple thyristor circuits have been used for firing capacitor-discharge ignitrons in a plasma physics experiment. Experience of over 18,000 discharges shows that the problem of semiconductor failure in an environment of high voltage transients can be overcome by attention to screening and filtering. Speed limitations of present-day thyristors are discussed and found acceptable for medium-speed plasma experiments. Author

N68-16782# Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
THE RELATIONSHIP OF MAGNETIC MATERIAL PROPERTIES TO THE OPERATION OF A MAGNETIC SENSE AMPLIFIER DEVICE
F. J. Friedlaender and J. R. Eaton, Jr. Dec. 1967 217 p refs
Sponsored in part by Army, AF and NSF
(Contract N0014-67-A-0226-0004)
(TR-EE67-21; AD-663292)

The operation of a magnetic sense amplifier device is examined and a mathematical model is developed which relates the properties of the magnetic materials to the device operation. The magnetic materials utilized are square-loop ferromagnetic materials in the form of torroidal cores. The development of the model is based upon the observed behavior of the magnetic material during device operation. The magnetic sense amplifier device is capable of the detection of a small signal current which occurs at a known instant in time. By means of capacitor current feedback during cyclic excursions of the B-H loop, a voltage on an output winding can be made to build up in a parametron-like manner. The output voltage, after a known time delay, is of the polarity as the original signal current, but has significantly greater voltage than that due to the signal current. The analysis method used is the analysis of the waveforms during device operation. The waveforms are considered to be piecewise analytic functions of time. The capacitor charges and core flux linkages are matched at the boundaries of the intervals over which the analytic functions are valid waveform representations. The material properties which are significant during the time when amplification takes place are characterized in terms of the S-Curves, which are defined in this work. A circuit gain is defined in terms of the flux linking an output winding. This gain is found to depend on the material properties as determined from the S-Curves, the circuit element values, the drive pulse widths and the drive pulse amplitudes. Experimental gain data given confirms the theoretical model. Author (TAB)

N68-16789# Weapons Research Establishment, Salisbury (Australia).
DESIGN DATA FOR UHF CIRCULATORS
K. B. Whiting Aug. 1966 38 p refs
(WRE-TN-WPD-34) CFSTI: HC $3.00/MF $0.65

A computational technique has been utilized to solve the equations governing the circulation conditions for a ferrite-loaded stripline Y-junction. Design curves are given for various modes of circulation, for a range of stripline geometries. Experimental results for above resonance operation have shown satisfactory agreement with the calculated values, over the frequency range 700 to 2,500 Mc/s. Author

N68-16802# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
SWITCHING OF HIGH CURRENT IMPULSE GENERATORS WITH FOUR ELECTRODE SPARK GAPS [ZALACZANIE GENERATOROW UDAROW PRADOWYCH ISKIERNIKAMI CZTEROELEKTRODO-WYMI]

Andrzej Jerzykiewicz and Marek Sadowski 1967 41 p refs
In POLISH; ENGLISH summary
(INR-823/XVIII/PP)

Technical requirements of spark gaps at parallel action are discussed and triggering devices for four electrode spark gaps are described. Operating characteristics of time delay to breakdown and jitter time versus applied dc voltage and triggering voltage are given. The results of research on parallel action of spark gaps in the six-section impulse current generator are described.
Author (NSA)

N68-16803# Gt. Brit. National Inst. for Research in Nuclear Science, Chilton. Rutherford High Energy Lab.
INTRODUCTION TO TRANSISTOR CIRCUIT TECHNIQUES
L. J. Herbst Jun. 1967 126 p refs
(RHEL/R-133) CFSTI: HC $3.00/MF $0.65

The notes prepared for a course of ten lectures held at Reading College of Technology in the autumn of 1966 are presented. The lectures deal with low and high frequency amplification, and also switching techniques, where the emphasis is on integrated circuit practice. The final lectures contain brief introductions to field effect transistors and digital integrated circuits. The notes are in their original form, but a number of worked examples have been added to the end.
Author (NSA)

N68-16804# Sperry Rand Research Center, Sudbury, Mass.
DEVELOPMENT PROGRAM ON MAGNETOELASTIC WAVE AMPLIFIER Final Technical Report, Jun. 30, 1966–Jun. 30, 1967
H. Matthews and D. H. Lyons Oct. 1967 52 p refs
(Contract AF 19(628)-5167; ARPA Order 498)
(SRRC-CR-67-51; ESD-TR-67-573; AD-663221)

A general theory of parametric excitation of spin waves by a traveling phonon in a ferromagnet is presented. The theory yields expressions for the minimum phonon intensity required for excitation of a pair of spin waves. For certain cases of practical interest the threshold expressions together with the conservation conditions for parametric amplification are used through a computer program to generate curves of the functional relation between pertinent variables. Experiments utilizing suitable transducers and ferrimagnetic material are described. These experiments extend observation of the basic phenomena to include phonon pumping by transverse waves. An amplifier device, of exploratory nature, was designed and tested.
Author (TAB)

N68-16826# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
LOW-POWER BACKWARD-WAVE TUBES
Yu. G. Al'tshuler and A. S. Tatarenko 24 Apr. 1967 237 p refs
Transl. into ENGLISH of the book "Lampy Maloy Moshchnosti s Obratnoy Volnoy" Moscow, Izdatel'stvo Sovetskoye Radio, 1963 p 1–296
(FTD-MT-65-273; AD-663350)

The book covers the theoretical and design fundamentals of low-power backward-wave transmitting tubes and is recommended as a textbook for advanced radio engineering students. The electronics of backward-wave generators are discussed and various types of delay systems are analyzed, including the opposite-pole type and the ladder type. The main methods of analyzing delay systems are presented: the electrodynamic method, the equivalent circuit method, and the multiwire line method.
Author (TAB)

N68-16866*# National Aeronautics and Space Administration, Washington, D. C.
PIEZOELECTRIC PRESSURE PICKUP
M. V. Gusev and O. I. Luneva *In its* Studies in Phys. Gas Dyn. Feb. 1968 p 234–243 refs (See N68-16839 07-12)

Design and performance data for several piezoelectric pressure pickups applicable in measuring the pressure of gases and liquids behind incident and reflected shock waves, and for studying detonation phenomena; are presented.
S.C.W.

N68-16890*# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
STUDY OF THE APPLICATION OF PLANAR ELECTROLUMINESCENT PANEL TECHNIQUES Final Project Report, 13 Jun. 1966–13 Jan. 1967
T. L. Robinson 13 Jan. 1967 41 p refs
(Contract NAS5-10192; Proj. Display 1)
(NASA-CR-92666; CAL-IM-2280-E-1) CFSTI: HC $3.00/MF $0.65 CSCL 09A

To meet the requirements for a visual display capable of presenting the status of electrical and mechanical systems in space vehicles, research was conducted on the application of planar electroluminescent (PEL) panel techniques to system configuration displays. In the approach used, electrodes and phosphor elements of the PEL panel are disposed on the same surface, and the displacement current is lateral with respect to the surface. This arrangement reduces the panel structure to a single layer. A series of PEL test cells was fabricated and tested under varying conditions of voltage, frequency, time, and phosphor formulation. The instrumentation for measuring the brightness output as a function of voltage, frequency for various phosphors and binder ratios is shown, and details are given on the fabrication procedures including etching, vacuum deposition, electroplating, and coating of the cells. An experimental antenna block diagram system for the RAE-A satellite was developed. Thin film deposition techniques for fabricating a PEL X–Y mosaic display are detailed. The results show that the PEL concept can be used in large-area configuration displays having more than one color.
M.G.J.

N68-16961*# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.
THIN FILM DIODES
M. Eschwei *In its* Microwave Res. Inst. Programs Nov. 1967 p 129–131 (See N68-16927 07-10)
(Grant NsG-589) CSCL 09A

A thin film vacuum diode was fabricated from gold–silver–gold films without the SiO insulation at the crossing areas. The top gold layer formed the "overpass". Several diode film runs with silver thicknesses ranging from 400 to 1000 Å indicated shorts between the two gold films. Technical improvements were suggested for future trial runs.
G.G.

N68-17009*# Columbia Univ., New York. Electrical Engineering Dept.
SMALL SIGNAL CHARACTERISTICS OF DIODE STABILIZED LINEAR INTEGRATED DEVICES
Edward S. Yang [1967] 20 p refs
(Grants NGR-33-008-090; NSF GK-1550)
(NASA-CR-92834) CFSTI: HC $3.00/MF $0.65 CSCL 09A

Small-signal characteristics and frequency response of diode-stabilized linear integrated circuits are examined. The built-in feedback property is explained. It is found that the circuit provides low input impedance, high output impedance and small internal feedback. The frequency response of the circuit with the bias-diode is superior to that without the bias-diode. The current gain of the circuit can be controlled by appropriate design of active elements or passive elements. The experimental results using discrete components agree with the analysis.
Author

N68-17073*# General Electric Co., Schenectady, N. Y. Microwave Tube Business Section.
DEVELOPMENT OF HIGH VOLTAGE–HIGH CURRENT SWITCHES Final Report
H. N. Price 28 Feb. 1968 40 p ref
(Contract NAS8-20526)
(NASA-CR-61519) CFSTI: HC $3.00/MF $0.65 CSCL 09A

This report describes work performed for the development of a triggered vacuum gap with the essential characteristics of the GL-7703 capacitor-discharge Ignitron, but with the added advantage of being independent of operating position. The development program included envelope and electrode design; trigger design and characteristics evaluation; construction and evaluation of development samples; life test; and construction, test, and delivery of final samples. The resulting triggered vacuum gap, ZR-7520, is capable of repetitive operation at the voltage, current, and energy levels appropriate to the intended application, and provides operation which is free from the environmental limitations imposed by mercury pool tubes. Author

N68-17083# Royal Aircraft Establishment, Farnborough (England).
LOW VOLTAGE CONTACTLESS SWITCHING USING THYRISTORS [KONTAKTLOSES SCHALTEN MIT STEUERBAREN HALBLEITERELEMENTEN IM NIEDERSPANNUNGSBEREICH]
K. Heumann and F. Koppelmann Oct. 1967 17 p refs Transl. into ENGLISH from ETZ-A, v. 86, no. 17, 1965 p 552–557
(RAE-LIB-TRANS-1254) CFSTI: HC $3.00/MF $0.65

The use of antiparallel pairs of thyristors as contactless ac switches is described. It is pointed out that the dc transient component of current when switching on can be avoided by appropriately triggering the thyristors. Thyristor switches can also be used for the contactless reversal of polyphase motors. The voltage, current, power and overload limitations of such thyristor switches are examined. Further circuit developments, such as the use of mechanical isolating and bridging switches to relieve the voltage and current loading of the thyristors, and delayed triggering for the control of mean current and power are described. Thyristors can also be used for both on/off switching and power control in dc circuits, although a capacitor discharge circuit is needed to interrupt the thyristor current for a period long enough to enable the thyristor to revert to the blocked state. It is considered that contactless thyristor switching will find its main future application in power and motor control circuits of limited voltage and power rating, especially those which are subject to high rates of operation. Author

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N68-16132# General Precision, Inc., Little Falls, N. J.
A REPORT ON COMPUTER-AIDED CIRCUIT ANALYSIS AND DESIGN
V. A. Baker Jun. 1967 39 p refs

The problems of circuit analysis and circuit design are discussed in relation to the computer procedures which are being developed for their solution. The complexity of the design problem is emphasized, and the technical skills required to advance the state-of-the-art are noted. Detailed theoretical data are presented on the mathematical foundations of circuit analysis, with attention centered on linear circuits in steady state, and in transient state; state-variable techniques; frequency domain analysis; nonlinear circuits; and electronic devices. Four circuit analysis computer programs are briefly described: (1) ECAP, a large-scale time domain analysis program capable of dc, ac, and transient analyses; (2) NET-1, capable of performing nonlinear dc steady state, and transient analyses; (3) CIRCUS for dc and transient analyses of circuits subjected to permanent or transient radiation; and (4) SCEPTRE, a general analysis program. B.S.D.

N68-16134# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
ANALYSIS OF FAST TWOFOLD AND MULTIFOLD COINCIDENCE CIRCUITS INFLUENCED BY STATISTICAL TIME SPREADS [ANALIZA SZYBKICH UKLADOW KOINCYDENCJI DWU- I WIELOKROTNYCH PRZY UWZGLEDNIENIUM STATYSTYCZNEGO ROZRZUTU OPOZNIEM]
Jozef Kalisz 1967 100 p refs In POLISH; ENGLISH summary
(INR-806/3/E)

The problems involved in determining statistical parameters of coincidence circuits, resolving time, jitter breadths, and efficiency are discussed. Analysis is carried out at the assumption of Gaussian jitter distributions. Two methods, slope method and point method, are presented allowing determination of these parameters if a single empirical coincidence curve is given. Utilizing the digital computer allowed for obtaining the tables and clear diagrams. The methods were presented for double and triple coincidence circuits and next generalized for multifold coincidence circuits. The concepts of coincidence surface and coincidence hypersurface are discussed. The use of the presented theory was illustrated by some numerical examples. Author (NSA)

N68-16149 Bolkow Entwicklungen K. G., Munich (West Germany).
APPLICATION OF NEW PROCESS ON THE CONTROL OF ROTATING BODIES IN SPACE [ANWENDUNG EINES NEUEN VERFAHRENS AUF DIE REGELUNG ROTIERENDER KOERPER IM RAUM]
Kitzig 29 Aug. 1967 33 p refs In GERMAN
(RS-26-O)

Transformation analysis is applied to spinning vehicle control synthesis. Systems equations are reduced to a linear system that describes simple control functions. Retransformation into the original system then gives the final control function with its coupling parameters. Author

N68-16268*# Columbia Univ., New York. Dept. of Electrical Engineering.
RECIPROCITY IN NONLINEAR NETWORKS
Thomas E. Stern [1967] 21 p refs
(Grant NGR-33-008-090; Contract Nonr-4259(04); Grant NSF GP-2789)
(NASA-CR-92836) CFSTI: HC $3.00/MF $0.65 CSCL 09C

Techniques for solution of nonlinear network analysis problems are compared with approaches used in linear network analysis. Cited are qualitative problems involving: (1) equilibrium equations for a network of resistors and sources; (2) an RLC network, possibly containing constant sources but no other excitation; and (3) an RLC network driven by time-varying sources. The importance of considering reciprocity and quasilinearity in nonlinear network analysis is mentioned. Six examples are discussed based on solutions of resistive network equilibrium equations, emphasizing reciprocity and quasilinearity properties. E.C.

N68-16359# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
A REVIEW OF STUDIES IN THE FIELD OF ELECTRONICS AND INSTRUMENTATION. REPORT NO. 1: STUDIES ON RADIATION [COORDINAMENTO DELLE ATTIVITA NEL CAMPO DELL'ELETTRONICA E DELLA STRUMENTAZIONE. RAPPORTO N. I. RIVELAZIONE DI RADIAZIONI]
B. Rispoli 1967 81 p refs In ITALIAN
(RT/EL-(67)4)

A series of meetings were held to coordinate work and research at Italian laboratories on electronics and instrumentation. Papers were presented reviewing the work done at Casaccia, Frascati, Bologna, and the Ionizing Gas Laboratory. Abstracts were given of papers published on counter tubes and thermopiles for neutrons, thermoluminescence, neutron detectors, ionization

chambers, γ–γ coincidence spectrometer, measurement of neutrons from pulse sources, techniques used for electromagnetic radiations, scintillation chambers, image intensifiers, detectors for measurement of neutron dose and flux, and Perlow neutron spectrometer. Two papers were presented in full: "Silicon Detectors of the Surface Barrier Type for High Resolution α and β Spectrometry" and "Complex for Measurement of Thermoluminescence." In the first paper the technological procedures for preparation of Si surface barrier detectors are outlined and methods for improving their resolving power are indicated. The particular techniques used at Casaccia are described in detail. The characteristics of the Si detectors obtained were measured and the results are reported. In the second paper an installation for the measurement of thermoluminescence is described. The installation consists of a unit for the detection and measurement of the thermoluminescence and of a thermocontrol unit. NSA

N68-16639*# Massachusetts Inst. of Tech., Cambridge. Electronic Systems Lab.

OPTIMAL PIECEWISE CONSTANT SOLUTIONS OF THE LINEAR REGULATOR PROBLEM

Thomas Fortmann Oct. 1967 35 p refs

(Grant NGR-22-009-124)

(NASA-CR-92740; ESL-R-326) CFSTI: HC $3.00/MF $0.65 CSCL 09C

The solution of the optimal linear regulator problem with a quadratic cost functional involves a time-varying matrix (the solution of a matrix Riccati differential equation) in the feedback loop. One suboptimal approach to the problem which simplifies implementation is to let the time-varying matrix be piecewise constant. A computer program is presented here which calculates the (sub) optimal feedback gains under this constraint, where the plant, cost functional, and switching times are specified a priori, and results are obtained for a third-order example. Author

N68-16661*# Columbia Univ., New York.

STATE-OF-THE-ART ORIENTED REVIEW OF CIRCUS

T. E. Stern and H. D. Eskin [1967] 5 p refs

(Grant NGR-33-008-090)

(NASA-CR-92800) CFSTI: HC $3.00/MF $0.65 CSCL 09C

Mathematic procedures are discussed for CIRCUS, a digital computer program which is based on a built-in model library and is capable of time domain analysis of certain circuits. While the program has limited flexibility, generality, and growth potential, the restriction on the device model increases computational efficiency and reduces the likelihood of anomalous results. Formulation of network equations, computation of initial conditions, and exponential integration of differential equations are discussed for the program. M.W.R.

N68-16717# Purdue Univ., Lafayette, Ind. School of Electrical Engineering.

ON GENERALIZATIONS OF ADAPTIVE ALGORITHMS AND APPLICATION OF THE FUZZY SETS CONCEPT TO PATTERN CLASSIFICATION

K. S. Fu and W. G. Wee Jun. 1967 199 p refs

(Grant NSF GK-696)

(TR-EE67-7; PRF-4502; PB-175610) CFSTI: HC $3.00/MF $0.65

There are essentially three main investigations undertaken in this thesis: (1) The application of fuzzy sets concept to generate a set of discriminant functions for two pattern classes; (2) Generalizations of the adaptive procedures for the discriminant functions needed in (1); and, (3) The application of a fuzzy automation learning model to pattern classification problem. Author

N68-16749*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

EFFECTS OF CORRELATED NOISE WITH APPLICATIONS TO APOLLO TRACKING PROBLEMS

B. Kruger Washington Feb. 1968 59 p refs

(NASA-TN-D-4121) CFSTI: HC $3.00/MF $0.65 CSCL 09D

The standard deviation η_i and the rms standard deviation $\bar{\eta}$ of least-squares fitted polynomials are analyzed in this paper. The general equations derived are demonstrated on several Apollo tracking problems: It is shown that $\bar{\eta}$ does not improve for higher sampling rates of angular data than 2 or 5 per second, for narrow and wide bandwidth setting of the angular servoloops, respectively. (Apollo GO, NO-GO decision.) The effect of negative correlation of measurement errors is analyzed. The effect of phase noise in range rate data is reduced by a factor $\sqrt{N}$ due to the negative correlation of $-1/2$ between adjacent measurement points. The effect of random-walk phase noise on the range rate data is shown to be proportional to the two-way propagation time of the signal. The maximum error in a least-squares fitted polynomial is also analyzed. Author

N68-16790*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

SYNTHESIS OF ACTIVE RC NETWORKS CONTAINING DISTRIBUTED AND LUMPED ELEMENTS

W. J. Kerwin [Nov. 1967] 11 p refs Presented at the Asilomar Conf. on Circuits and Systems, Pacific Grove, Calif., 1–3 Nov. 1967

(NASA-TM-X-60856) CFSTI: HC $3.00/MF $0.65 CSCL 09C

A practical procedure for synthesizing distributed, lumped active (DLA) networks is developed by determining a set of equivalent rational pole positions corresponding to the amplitude response of three specific DLA networks which together allow the realization of filters with left half-plane poles and $j\omega$ axis zeros. An example of the synthesis of a 5-pole, 4 $j\omega$ axis zero elliptic function low-pass filter is given. Author

N68-16918*# California Univ., Los Angeles. Dept. of Engineering.

A NONLINEAR PERTURBATION THEORY FOR ESTIMATION AND CONTROL OF TIME-DISCRETE STOCHASTIC SYSTEMS

H. W. Sorenson (Ph.D. Thesis) Jan. 1968 244 p refs

(Grant NsG-237-62)

(NASA-CR-92981; Rept.-68-2) CFSTI: HC $3.00/MF $0.65 CSCL 09C

The problem of determining optimal estimation and control policies from noisy measurement data for time-discrete, stochastic, dynamic systems is considered. The method proposed represents a generalization of the common approach based on an application of linear theory. If it is assumed that the state and measurement perturbations of the actual system relative to an arbitrary system can be described by linear equations, then, it is possible to apply well-known linear techniques to estimate the state of perturbations and to determine the desired control corrections. In this investigation, terms of higher order than first are retained in describing the perturbations. The determination of estimation and control policies for the resulting nonlinear systems is then accomplished within the framework of the so-called Bayesian approach. Author

N68-16919*# California Univ., Los Angeles. Dept. of Engineering.

CONTROLLABILITY OF DISTRIBUTED PARAMETER SYSTEMS

Charles John Herget (Ph.D. Thesis) Oct. 1967 99 p refs

(Contract NAS8-21019; Grant NsG-237-62)

(NASA-CR-92983; Rept.-67-56) CFSTI: HC $3.00/MF $0.65 CSCL 09C

A summary of the techniques applicable to control systems problems is given. The eigenvalue–eigenfunction expansion method for the solution of homogeneous boundary value problems (BVP)

is used. Problems in which the control appears at the boundary are treated by converting the non-homogeneous BVP to an equivalent homogeneous BVP by introducing generalized functions. The generalization of the concept of controllability of finite dimensional systems to infinite dimensional systems is given. The pseudo-inverse of a linear operator is defined which is a generalization of that of a matrix for finite dimensional spaces. The pseudo-inverse is then used to obtain minimum energy control for distributed parameter systems. It is shown that this generalization includes results for finite dimensional systems which are available. In the infinite dimensional problem, it is necessary to solve for the eigenvalues and eigenfunctions of an integral operator. The necessary and sufficient conditions for the states which are reachable when the control is required to satisfy a norm constraint are given. The conditions are obtained by an application of the moment problem to distributed parameter systems. These results are then used to obtain conditions for complete controllability. Author

N68-16927# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.

MICROWAVE RESEARCH INSTITUTE PROGRAMS Progress Report, 15 Mar.–14 Sep. 1967

Arthur A. Oliner Nov. 1967 297 p refs

(Contract AF 49(638)-1402)

(PIBMRI-R-452.32-67; AFOSR-67-2582; PR-32; AD-662885)

Summarized are research programs ranging from basic theoretical physics, mathematics, and engineering, to experimental investigations involving basic measurements, development of devices, and materials. Contributions are compiled under the following headings: electromagnetic and waveguide techniques; quantum electronics and optics; plasma physics and electronics; solid state and materials; control theory and computer science; communications and information processing; and network and systems. For individual titles see N68-16927 thru N68-16996. Author

N68-16939# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.

NEW MILLIMETER-WAVE TECHNIQUES: AMPLIFIER NOISE THEORY

B. Senitzky *In its* Microwave Res. Inst. Programs Nov. 1967 p 54–57 refs (See N68-16927 07-10)

(Grant NSF GU-1557)

Theoretical and experimental work is reported to determine the fundamental noise limitations in an amplifier that consists of a small cylindrical cavity, resonant at 258 GHz, and fitted with gas under pressure. When the molecular resonance and the cavity resonance coincide, a monochromatic pump signal is sufficient to bias the gas to its saturation region and the weak incoming signal can then be reflected with gain. The limiting noise of the amplifier is due to spontaneous emission of gas molecules in cavity. Computation of the emission spectrum gives the estimated minimum room temperature noise figure for the amplifier as about 5 db. G.G.

N68-16940# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.

NEW MILLIMETER-WAVE TECHNIQUES: AMPLIFIER NOISE EXPERIMENT

T. Kihm and B. Senitzky *In its* Microwave Res. Inst. Programs Nov. 1967 p 58–61 refs (See N68-16927 07-10)

(Grant NSF GU-1557)

We have studied the frequency stability and made a preliminary investigation of the A.M. noise power of the Varian VC 715 Klystron which operates at 140 GHz. We found that this klystron can be stabilized to better than 1:10^7, although certain precautions have to be taken. The ratio of its A.M. noise power per Hz (at 10^3 Hz away from the coherent pump frequency) to the pump power is less than 10^{-14}. At present we do not known how much less. In order to determine our amplifier noise, this ratio will have to be about 10^{-16} Author

N68-16968# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.

TWO METHODS FOR FINDING TESTING EXPERIMENTS BY THE USE OF REGULAR EXPRESSIONS

S. E. Gelenbe and E. J. Smith *In its* Microwave Res. Inst. Programs Nov. 1967 p 160–161 (See N68-16927 07-10)

In this work, the algebra of regular expressions is applied to the systematic design of diagnostic tests for finite-state automata. The class of finite, deterministic automata considered is restricted to those machines possessing a diagnosing sequence. It is assumed that the failures to be detected are intermittant and that the machine is so constructed that no failure will increase the number of its states or, equivalently, that the failures which are detectable by this method do not increase the number of states of the machine. The two methods described here are not restricted to single-input, single-output binary machines; however, the machines examined are expected to be strongly connected before any failure has occurred. Author

N68-16970# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.

ON OBSERVERS IN MULTIVARIABLE CONTROL SYSTEMS

J. J. Bongiorno, Jr. and D. C. Youla *In its* Microwave Res. Inst. Programs Nov. 1967 p 164–166 refs (See N68-16927 07-10)

(Contract AF 49(638)-1373)

The construction of compatible observers for a linear, time invariant, finite dimensional dynamic system is discussed. A compatible observer is defined as one whose output equals the state of the plant to within an exponentially decaying error. When a compatible observer is used in a system which is optimal, if the state of the plant is observed without error, an increase in the cost or performance index takes place. A formula is developed that shows that the increased cost in a single-output plant can not be decreased by giving the eigenvalues of the observer real parts approaching–∞value. G.G.

N68-16972# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.

OPTIMAL BANG-BANG CONTROL OF STOCHASTIC SYSTEMS WITH A SMALL NOISE PARAMETER

P. Dorato, C-M. Hsieh, and P. N. Robinson *In its* Microwave Res. Inst. Programs Nov. 1967 p 168–171 ref (See N68-16927 07-10)

(Contract DA-31-124-ARO(D)-316)

Considered is the problem of determining a feedback control law which minimizes the performance index for a given dynamic plant with control input constraint. For a given feedback law, the plant dynamics generate a Markov process; it can be shown that a formal application of dynamic programming concepts yields the optimization equation for a control input of the bang–bang type. G.G.

N68-16973# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.

APPROXIMATION OF MULTIDIMENSIONAL LINEAR SYSTEMS

S. Shapiro *In its* Microwave Res. Inst. Programs Nov. 1967 p 171–172 refs (See N68-16927 07-10)

Proposed is an approximation method for reducing the order of a linear system where the state vector is of a dimension considerably greater than that of the output vector. This method replaces the actual system by one of lower order whose parameters are chosen to provide an optimum approximation; optimum in the sense of least square error between the impulse responses. G.G.

N68-16987 Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.

ON THE CASCADE DECOMPOSITION OF LOSSLESS 2-PORTS

D. C. Youla *In its* Microwave Res. Inst. Programs Nov. 1967 p 236–241 refs (See N68-16927 07-10)
(Contract AF 30(602)-3951)

A simple algorithm for effecting the decomposition of a given lumped, passive, reciprocal, lossless 2-port N into a cascade N_1N_2 of two simpler reactive 2-ports N_1,N_2 is given that uses the transfer scattering matrix in canonic form to obtain the minimum numbers of reactances sufficient for the synthesis of N_1, N_1 and N_2 equal. The decomposition is called minimal if the minimality implies the equality. A four dimensional transformation of 4-pole matrices is then used to find permissible solutions and to complete the design procedure outline which achieves the desired partition. G.G.

N68-16988# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.

THE SYNTHESIS OF FILTERS USING CASCADED LOW-PASS LUMPED SECTIONS AND TRANSMISSION LINES OF COMMENSURATE LENGTH

G. Ott and D. C. Youla *In its* Microwave Res. Inst. Programs Nov. 1967 p 241–244 (See N68-16927 07-10)
(Contract DA-31-124-ARO(D)-363)

Chain matrices of a series inductor, a shunt capacitor, and a transmission line of characteristic length and impedance are used to determine the conditions that satisfy a two variable positive real impedance function. The function is to be realized as the input impedance of a cascade of series inductors, shunt capacitors, and commensurate length of transmission line terminated in a positive resistor. G.G.

N68-16989# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.

ON THE CLASS OF NORMALIZATION FUNCTIONS ADMISSIBLE FOR A PRESCRIBED SCATTERING MATRIX

T. M. Chien and D. C. Youla *In its* Microwave Res. Inst. Programs Nov. 1967 p 244–247 refs (See N68-16927 07-10)
(Contract AF 30(602)-3951)

It is well known that S(p) can always be interpreted as the scattering matrix of a lumped, linear, passive, time-invariant n-port, normalized to a set of n real positive numbers, since the advent of complex normalization, it is natural to ask whether S(p) can be similarly interpreted when the normalization numbers are replaced by a set of n positive real, rational, non-foster functions, $z_1(p),\ldots,z_n(p)$. It turns out that the answer is positive and a constructive procedure for finding all admissible $z_1(p),\ldots,z_n(p)$ can be established. Author

N68-16990# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.

REAL TIME SCALING

A. Papoulis *In its* Microwave Res. Inst. Programs Nov. 1967 p 247–254 (See N68-16927 07-10)
(Contract AF 49(638)-1402)

Proposed is a system yielding as output the signal f(ct) when a signal f(t) and a constant c is given. It is shown that such a system can be realized by two all-pass filters with quadratic phase and a linear FM generator. Results are direct analogies of corresponding optical phenomena; basic is the optical analog that on its image plane, an object f(x) generates the field f(cx). Thus, a spectrum analyzer formula is obtained that corresponds to the fact that the field on the focal plane of the lens is proportional to the Fourier transform of the incident wave. G.G.

N68-16991# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.

LIMITS OF BAND-LIMITED SIGNALS WITH APPLICATIONS IN NUMERICAL ANALYSIS

A. Papoulis *In its* Microwave Res. Inst. Programs Nov. 1967 p 255–257 (See N68-16927 07-10)
(Contract AF 49(638)-1402; Grant NSF GU-1557)

Developed is a numerical method for evaluating errors resulting from approximation derivatives by viewing them as responses of suitable created systems and by applying Schwarz's inequality to the resulting output of the linear system that contains a random signal with power spectrum. Example calculations are given for the determination of signal bounds, truncated Taylor series, and truncated sampling expansion for two dimensional signals and Hankel transforms. Results are used to give asymtotic solutions to the problem of maximizing the energy of a signal f(x,y) in a region R of the x–y plane. G.G.

N68-16992# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.

DECODING OF BOSE–CHADHURI–HOCQUENHEIM CODES AND PRONY'S METHOD FOR CURVE FITTING

Jack Wolf *In its* Microwave Res. Inst. Programs Nov. 1967 p 257–259 refs (See N68-16927 07-10)
(Contract AF 49(638)-1600)

Compared are common sets of equations that are found in algebraic coding theory and in curve fitting. The first problem approximates a curve f(x) by a finite set of exponentials and uses the obtained set of linear equations for comparison with those resulting from the algorithm for decoding Bose–Chaudhuri–Hocquenheim codes. The correspondence of the terms is obvious. One difference being that in the curve fitting problem, fields of complex numbers are used while in the coding problem finite fields are used. G.G.

N68-16993# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.

CANONIC SYNTHESIS OF LOSSLESS ONE PORTS WITH SYMMETRIC MUTUALLY COUPLED INDUCTORS

J. D. Williams and H. Ruston *In its* Microwave Res. Inst. Programs Nov. 1967 p 259–262 (See N68-16927 07-10)
(Grant NSF GK-236)

A new canonic synthesis method of LC driving-point functions has been developed. This procedure uses symmetric mutually coupled inductors. The synthesis consists of a reduction process in which each reduction cycle removes a section consisting of two capacitors and a pair of symmetric mutually coupled coils. This removal leaves a remainder impedance which has a lower rank but the same form as the original impedance and satisfies the realizibility conditions for LC driving-point functions. In this work, four new dual pairs of canonic cycles are developed. Author

N68-16994# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.

EVALUATION OF EXPECTED PERFORMANCE USING ORTHONORMAL FUNCTIONS

L. Shaw and P. Chalon *In its* Microwave Res. Inst. Programs Nov. 1967 p 263–264 refs (See N68-16927 07-10)
(Contract DA-31-124-ARO(D)-316)

For a linear plant with a single random parameter r and a design parameter b, the transient performance measure was evaluated by forming an infinite set of linear differential equations with constant coefficients $c_i(t)$ depending on the statistics of r and the value of b. These equations result from substitution of the orthonormal expansion into the system equations. When Walsh functions are used for the orthonormal set, and the coefficients in the original system equations are polynomials in a uniformly distributed random variable r, a sparse A matrix results that is particularly well suited for computer solution of the truncated C_N vectors. G.G.

N68-16996# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.

SYSTEM RELIABILITY AND AVAILABILITY MODELING

M. Messinger and M. Shooman *In its* Microwave Res. Inst. Programs Nov. 1967 p 268–270 refs (See N68-16927 07-10)
(Contract AF 49(638)-1402)

Models and approximations for reliability analyses on large redundant structures comprise: (1) probabilistic approximations for structures of the k out of n type, (2) chain type structures where all redundancy is introduced on the component level; (3) non-repaired structures with component dependence; (4) reliability and availability analyses of systems with repair; and (5) computer techniques for combined structures and structures containing dependent components. The Monte Carlo method is determined as the best analyzing system for complicated structures with repair G.G.

N68-17053*# North Carolina State Coll., Raleigh.
A STUDY OF H-GUIDES WITH ARTIFICIAL DIELECTRICS
Progress Report
Frederick J. Tischer 15 Jan. 1968 173 p refs
(Grant NGR-34-002-047)
(NASA-CR-92802) CFSTI: HC $3.00/MF $0.65 CSCL 09

The study deals with H-guide structures with artificial dielectrics, with emphasis on a new type of H-guide, the corrugated H-guide. The guide's attenuation is computed, evaluated numerically, and compared with that of other waveguides. Results of measurements verify the analytical results. The attenuation for an infinite dielectric sheet, an infinite corrugated plane, and a dielectric H-guide are calculated. The distribution of the field components for the corrugated H-guide is determined using the method of field matching. From this, the attenuation is computed and evaluated numerically at various frequencies by computer. The attenuation of the corrugated H-guide is compared with a dielectric H-guide, a laminated dielectric H-guide, and a standard rectangular waveguide, all operating at 10 GHz. Measurements were made at 10 GHz to verify the analytical results for the corrugated H-guide structure. They were conducted in a transmission-type cavity which formed a shorted section of H-guide. Experimental techniques are described for determining the guide wavelength and attenuation. Author

N68-17150*# Columbia Univ., New York. Dept. of Electrical Engineering.
GENERATION AND DESCRIPTION OF A CLASS OF RANDOM PROCESSES
L. H. Brandenburg and H. E. Meadows [1967] 9 p refs
(Grant NGR-33-008-090; Contract Nonr-4259(04); Grant NSF GP-1505)
(NASA-CR-92799) CFSTI: HC $3.00/MF $0.65 CSCL 09C

The generation of a possibly non-stationary random process having a specified autocorrelation function is examined. If the class of auto-correlation functions under consideration is suitably restricted, a finite linear system to be excited by white noise may be determined which yields at its output a random process having the specified autocorrelation function. The determination of this linear system provides a spectral factorization for the random process. Simple criteria are thus obtained which serve to identify autocorrelation functions in the class. The positive definite character of such functions may be tested by a straightforward process related to the factorization technique. Moreover, conditions may be stated whereby the factorization and the results derived from it are valid globally. Author

N68-17160# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THEORY OF AUTOMATIC CONTROL AND ADJUSTMENT
A. A. Ivanov 7 Apr. 1967 301 p refs Transl. into ENGLISH of the book "Teoriya Avtomaticheskogo Upravleniya i Regulirovaniya" Moscow, Izd.-Vo Nedra, 1964 p 1–331
(FTD-MT-65-433; AD-663319)

The book considers basic principles of constructing systems of automatic control and adjustment, including self-adjusting systems and systems of complex automatic control. Basic ideas on the theory of an automatic adjustment, in reference to linear and nonlinear systems, are given. The book is intended as a training aid for students of Automation of industrial processes, in higher educational institutions; it can also be used by students of mining specialties who are studying automatic control. TAB

N68-17163# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ENCYCLOPEDIA OF MEASUREMENT, CONTROL, AND AUTOMATION—SELECTED ARTICLES
3 May 1967 28 p refs Transl. into ENGLISH from Eika, Entsiklopediya Izmen., Kontrolya i Avtomatiz. (USSR), no. 3, 1964 p 39–44
(FTD-HT-66-773; AD-662585)

CONTENTS:

1. A PNEUMATIC ISODROMIC CONTROLLER WITH A BROAD THROTTLING RANGE V. I. Levin p 1–15 refs (See N68-17164 07-10)
2. AUTOMATIC SINGLE-CHANNEL OPTIMIZERS (MINIMAX CONTROLLERS) L. N. Fitsner p 16–22 refs (See N68-17165 07-10)

N68-17164# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A PNEUMATIC ISODROMIC CONTROLLER WITH A BROAD THROTTLING RANGE
V. I. Levin *In its* Encyclopedia of Meas., Control, and Automation 3 May 1967 p 1–15 refs (See N68-17163 07-10)

This is a tutorial article on adaptive and self-learning systems. After a brief definition of both of these classes of automatic search systems, an important subclass called the systems of automatic optimization is discussed. The search methods involved in evaluation of the location of the extremum, all based on trial perturbations of the input variables by the optimizer, are: blind search, which can be deterministic (fixed scan program), random or locally random, and search are limited. The three main methods of search with analysis of intermediate results are the Gauss–Zeidel method, the method of steepest descent (slope) and the gradient method. The search methods are illustrated by considering specific systems described in the literature. Author

N68-17165# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AUTOMATIC SINGLE-CHANNEL OPTIMIZERS (MINIMAX CONTROLLERS)
L. N. Fitsner *In its* Encyclopedia of Meas., Control, and Automation 3 May 1967 p 16–22 refs (See N68-17163 07-10)

Automatic optimizers are control devices which automatically evaluate and maintain one or more input variables of a controlled object in such a way that the output variable is maintained at its extremum value. The article describes 4 types of optimizers for single channel operations. The continously modulated optimizer uses a sinusoidally modulated input with a phase detector at the output of the object to indicate the location of the output with respect to the desired extremum of the transfer function. The discrete automatic optimizer computes, at discrete moments of time, the changes in the output due to discrete changes in the input. Consecutive changes of output are stored and compared in a memory to determine the overall direction of output drift and to introduce the necessary corrections at the input. The automatic optimizer with extremum memory uses a continuously changing input variable to locate and memorize the output extremum. After the extremum is passed, each current value of the output variable is compared with the extremum value and when the difference between these two exceeds a certain predetermined value the direction of change of the input is reversed, the memory is erased and a new cycle starts. The self-oscillatory type of automatic optimizer uses a polarized relay to determine the direction of change of the output variable. Author

N68-17167# Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
OPTIMUM FINITE SEQUENTIAL PATTERN RECOGNITION
K. S. Fu and G. P. Cardillo 1967 83 p refs
(Grant NSF GK-696)
(TR-EE67-9; PB-175690) CFSTI: HC $3.00/MF $0.65

A general formulation of sequential pattern recognition processes is presented within which a procedure is obtained for the simultaneous optimization of the stopping rule and the stage by stage ordering of features. The optimization procedure is based on backward programming and uses as an index of performance the expected cost of the process, including both the cost of feature measurements and the cost of classification errors. Examples are presented which allow a comparison with other statistical schemes, both sequential and non-sequential in nature. Some suboptimum procedures are developed which greatly simplify the design and the resulting system while retaining some of the optimality of the backward programming procedure. Examples indicate the applicability of the suboptimum procedures proposed. A modification to the backward programming procedure is employed to solve the problem of selecting an optimum subset of features from a given set for a nonsequential pattern recognition process. Finally, the sequential pattern recognition process is discussed from a learning system viewpoint and a method for non-supervised (on line) learning is developed for incorporation into the sequential system. An example of the operation of the learning algorithm is provided. Author

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N68-16181# Central Mechanical Engineering Research Inst., Durgapur (India).
DESIGN OF HIGH ALTITUDE CHAMBER FOR TESTING ENGINES
M. M. Shah Aug. 1967 16 p refs
(A9)

The various possible ways in which the altitude conditions can be simulated is discussed and the general principles for designing suitable test chambers are described. Four simulation systems are suggested offering varying degrees of precision and ranges of cost. The refrigeration plant is dealt with in some detail and the two-stage compound compressor system is recommended for most cases. Methods for calculation of load, and pull-down time are also discussed. Author

N68-16248# Akademiya Nauk URSR, Kharkov. Fiziko-Tekhnicheskii Inst.
SHORTENING THE CURRENT PULSE IN A TWO-SECTION LINEAR ACCELERATOR [UKOROCHENIE TOKOVOGO IMPUL'SA NA DVUKHSEKTS IONNOM LINEINOM USKORITELE]
V. A. Vishnyakov, A. I. Zykov, V. M. Grizhko, and I. A. Grishaev 1966 11 p refs In RUSSIAN
(NP-17013)

The experimental study of the effect of various factors on the character of the beam break-down was reported. The results were compared with calculated effects. The methods used for determination of the critical current are described. The dependence of the critical current on the electron energy and the pulse duration was determined. The dependence of the critical current on the length of the diaphragm waveguide was also measured. NSA

N68-16355# ARO, Inc., Arnold Air Force Station, Tenn.
ALTERATION OF THRUST STAND DYNAMICS USING HYDRAULIC FORCE FEEDBACK Final Report, May–Aug. 1967
Sam P. Ragsdale Dec. 1967 48 p refs
(Contract AF 40(600)-1200)
(AEDC-TR-67-232; AD-663236)

The report is concerned with the dynamic behavior of a rocket motor and thrust stand combination when restrained by a hydraulic force balance system. The system is analyzed taking into account the nonlinearities caused by limiting flow and fluid compressibility. The analysis is followed by a discussion of the data obtained from an analog simulation of the system. Investigations of the basic stand without the servo are followed by investigations with the servosystem installed for comparison purposes. Both the time and frequency domains are investigated using ramp and 1sinusoidal forcing functions of thrust. The results of this investigation show that many desirable advantages may be realized using hydraulic force feedback. The control signals may be adjusted to provide zero displacement of the rocket motor position during the steady portion of the firing and at the same time, provide a high degree of damping. Concurrent with these conditions, the acceleration of the rocket motor may be greatly reduced during the firing transient. Author (TAB)

N68-16384# Aerospace Research Labs., Wright-Patterson AFB, Ohio. Fluid Dynamics Facilities Research Lab.
SUPERSONIC COMBUSTION SIMULATION
Robert G. Dunn *In* Office of Aerospace Res. Proc. of the OAR Res. Appl. Conf., 14 Mar. 1967 Mar. 1967 p 157–182 refs
(See N68-16376 07-34)

A facility developed for simulating conditions in the combustor region of a high Mach number ramjet engine is described, and the ranges of specific parameters which can be duplicated are discussed. A parallel analytical investigation, made to define the laboratory conditions required for adequate simulation of supersonic combustion for high Mach number flight over a wide range of operation, blanketing the flight corridor in the Mach 10–14 region, is also described. This method of simulation makes possible basic investigation of supersonic combustion for hypersonic flight under conditions approaching those of actual flight. Results obtained in the early experiments are presented. Author

N68-16393* Farrand Optical Co., Inc., New York.
TWO STAR SIMULATOR Final Technical Report
Dec. 1967 93 p
(Contract NAS9-6064)
(NASA-CR-65943) CFSTI: $3.00 CSCL 14B

This report describes the design and manufacture of a two star simulator and beam combination unit. The instrument is designed to provide two separate variable magnitude stars of constant spectral output over the range of 3500 to 7000 Å, focused at infinity, with the capability of displacing one star relative to the other by as much as two degrees. The beam diameter for each star is three inches and the beam combination unit is designed so that the two three inch beams can be superposed at a distance of forty feet when the stars are displaced within the specified range. Author

N68-16555# European Space Technology Center, Noordwijk (Netherlands).
DETERMINATION OF THE SIMULATED SOLAR FLUX INCIDENT ON A SPACECRAFT IN A TEST CHAMBER
Marcel Toussaint Paris ESRO Jul. 1967 57 p refs
(ESRO-TM-11) CFSTI: HC$3.00/MF$0.65

The report describes the method of calculating the incident solar flux impinging on the skin of a satellite of any shape under conditions occurring in a thermal vacuum chamber. It is assumed that the lamps constituting the solar simulator can be considered as point-sources. Intensity patterns in planes orthogonal to the axis of the chamber, measured prior to the tests, are used in the calculations. The support system of the satellite allows two degrees of freedom. No account is taken of the effect of reflections. The specification and the listing of the program, and the data and results for a typical case are given. Author (ESRO)

N68-16648# California Univ., Berkeley. Lawrence Radiation Lab.
ENERGY EXPANSION OF THE 200-GeV ACCELERATION TO 400 GeV AND ABOVE BY CONSTRUCTION OF A SUPERCONDUCTING GUIDEFIELD
Michael A. Green 4 Aug. 1967 23 p refs Revised
(Contract W-7405-ENG-48)
(UCRL-17862; UC-28) CFSTI: HC$3.00/MF$0.65

This report proposes to extend the energy of the 200-GeV accelerator to higher energies by the addition of a superconducting synchrotron. The feasibility of such a system is discussed and cost estimates are made on a number of superconducting accelerator systems. Two basic types of machines are analyzed: a standard cycle accelerator system, and an accelerating storage ring system. Cost estimates are made on all of the major accelerator components and the conventional facilities. The effect of machine parameters on cost is shown. Author (NSA)

N68-16673# European Atomic Energy Community, Brussels (Belgium).
NUCLEAR INSTALLATIONS IN THE COUNTRIES OF THE EUROPEAN ATOMIC ENERGY COMMUNITY. FOURTH EDITION [REPETOIRE DES INSTALLATIONS NUCLEAIRES DE LA COMMUNAUTE EUROPEENNE DE L'ENERGIE ATOMIQUE. QUATRIEME EDITION]
Sep. 1967 120 p In FRENCH
(EUR-3568.f)

A listing of all the nuclear installations in the countries of the European Atomic Energy Community is presented. Included are those nuclear installations which already exist, those under construction, those not yet under construction but whose construction has been decided, and installations which are being planned. A short description is given of the main characteristics of each installation, and the more important enterprises which are known to have participated in the building of these installations are identified. Author (NSA)

N68-16695*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DESIGN AND PERFORMANCE OF TWO VACUUM CHAMBERS AND SOLAR SIMULATORS FOR SOLAR-CELL RESEARCH
Adolph C. Spagnuolo Washington Feb. 1968 18 p refs
(NASA-TM-X-1503) CFSTI: HC$3.00/MF$0.65 CSCL 14B

A facility containing a 5-foot- (1.52-m-) and a 2-foot- (0.61-m-) diameter space-environmental chamber with two solar-radiation simulators and support equipment is described. The facility is designed for testing solar cells, thermoelectric and thermionic devices, and related components at vacuum levels in the 10^{-6}- to 10^{-8}-torr (10^{-6}- to 10^{-7}-N/m^2) range. The pumping systems and liquid-nitrogen-cooled shrouds are described. Information concerning a test apparatus and a solar-cell installation method is also included. Author

N68-16785*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
UNIFORMITY OF PROTON BEAMS AVAILABLE AT THE NASA SYNCHROCYCLOTRON (SREL)
Gerald F. Hill, William C. Honaker, and K. H. Kim 1967 17 p refs Presented at the 53d Ann. Meeting of the Radiol. Soc. of North Am., Chicago, 26 Nov.–1 Dec. 1967
(NASA-TM-X-60860) CFSTI: HC$3.00/MF$0.65 CSCL 20G

Space radiation simulation is achieved by degrading either of the two primary extracted proton beams having measured energies of 595 MeV and 325 MeV. The primary extracted beams are degraded to lower energies by using copper absorbers located in the magnet hall of the facility. Proton beams having energies from 595 MeV to approximately 30 MeV can be obtained at the target position. Both small and large area beams are available over a wide energy range. The final beam configuration at the target position, however, is dependent upon the optimization of some 25 magnets located in the proton beam transport system (P.B.T.S.). Because of this, an extensive proton beam characterization study was initiated and recently completed. This paper summarizes the characteristics of approximately 30 beam configurations and includes such parameters as proton beam energy, energy spread, intensity, intensity profile, repeatability, and area. The results reported here are primarily related to large area beams which are of interest to experimenters studying the radiation effects of protons on animals. Uniformity of several large area beams is discussed in terms of dose rate (rads/min) in muscle. Author

N68-16826*# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
EXPERIMENTAL INVESTIGATION OF ULTRAHIGH VACUUM ADHESION AS RELATED TO THE LUNAR SURFACE Quarterly Progress Report, 27 Nov. 1967–31 Jan. 1968
J. A. Ryan and J. J. Grossman 31 Jan. 1968 31 p
(Contract NAS7-307)
(NASA-CR-92689; A-830-BBK3-11; QPR-13) CFSTI: HC $3.00/MF$0.65 CSCL 14B

Studies were concerned with (1) modifications of the experimental apparatus to permit study of the adhesional behavior of ultrahigh vacuum cleaved silicates in contact with metals of various surface state, and (2) construction of a second vacuum system to permit direct measurement of the magnitude and distribution of electrostatic surface charging produced during cleavage. The modifications consist of installation of apparatus to permit argon ion sputtering and mechanical abrasion of the metal surfaces. The second vacuum system contains an adjustable electrometer probe with associated electronics and recording equipment. The first run on silicate–metal adhesion was begun, and two runs measuring surface charge were completed. They demonstrated that vacuum cleavage of silicates does produce considerable surface charging, that this charging is macroscopically anisotropic, and that it persists over extended periods of time. Plots of charge magnitude versus time show a close correlation with previously obtained plots of adhesion force as a function of time. Author

N68-16925# California Univ., Berkeley. Lawrence Radiation Lab.
CONTROL OF THE CLOSED ORBIT IN SYNCHROTONS BY DISPLACEMENT OF MAGNETS
G. R. Lambertson and L. Jackson Laslett 6 Sep. 1967 8 p refs Presented at the 6th Intern. Conf. on High Energy Accelerators, Cambridge, Mass., Sep. 1967
(Contract W-7405-ENG-48)
(UCRL-17796; CONF-670930-18) CFSTI: HC$3.00/MF$0.65

A study of the effectiveness of magnet positional adjustments in the synchrotron as a corrective system for alignment of a closed orbit is discussed. Data on orbit displacements and the effects of noise are presented. Author (NSA)

N68-17102*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE MICROBIOLOGICAL ASPECTS OF STERILIZATION ASSEMBLY DEVELOPMENT LABORATORIES, EASL AND SADL
W. W. Paik and J. A. Stern 1 Mar. 1968 13 p refs
(Contract NAS7-100)
(NASA-CR-93140; JPL-TR-32-1207) CFSTI: HC $3.00/MF $0.65 CSCL 14B

Industrial clean rooms are used to reduce particulate contamination upon hardware. The accompanying reduction in microbial contamination has led to the investigation of laminar flow clean rooms for future use in spacecraft assembly. Minimizing the microbial contamination on spacecraft during assembly will enhance any sterilization process used to satisfy planetary quarantine requirements. Microbiological studies conducted in the Experimental Assembly and Sterilization Laboratory (EASL) indicated the feasibility of assembling spacecraft hardware in vertical laminar flow clean rooms. The advancements in technology and procedural knowledge gained from the EASL are continually being integrated with efforts within the Sterilization Assembly and Development Laboratory (SADL). Space hardware to be assembled in the SADL will be microbiologically monitored. This information will aid in the formulation of a final terminal sterilization process for spacecraft hardware. Author

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N68-16145# Institut Franco-Allemand de Recherches, St. Louis (France).
REFRACTION OF AERIAL SHOCK WAVES. PART 1: REFRACTION OF A SHOCK WAVE OF A CONSTANT INTENSITY IN AN ISOBAR ATMOSPHERE WITH VERTICAL TEMPERATURE AND WIND GRADIENTS [REFRACTION DES ONDES DE CHOC AERIENNES. 1ERE PARTIE: CAS D'UNE ONDE DE CHOC D'INTENSITE CONSTANTE SE REFRACTANT DANS UNE ATMOSPHERE ISOBARE AVEC GRADIENTS VERTICAUX DE TEMPERATURE ET DE VENT]
13 Jul. 1966 36 p refs In FRENCH
(ISL-T-14/66, Pt. 2)

A mathematical model is formed for calculating constant intensity shock wave refraction on the joint face of two media of almost equal density. It is shown that an increase as well as a decrease in passing shock wave intensity is possible and that near a certain refraction angle increase or decrease are optimal. Calculations on shock wave refraction in an atmosphere with constant vertical temperature distribution establish the strong effects of local acoustic velocities on shock wave intensity and the irregular ground refraction effects. Author

N68-16197# Central Mechanical Engineering Research Inst., Durgapur (India).
CONSTANCY OF THE DYNAMIC VISCOSITIES OF TERNARY GAS MIXTURES
G. J. Gura Raja and S. Watarajan Aug. 1967 9 p refs
(B3)

The dynamic viscosities of ternary gas mixtures oxygen–nitrogen–carbon dioxide and hydrogen–nitrogen–oxygen are investigated. Starting from Wilke's equation for the prediction of the viscosities of gas mixtures whose volumetric analysis is known, it is shown that in the case of oxygen–nitrogen–carbon dioxide mixture the viscosity at a particular temperature remains constant irrespective of the percentage of nitrogen present in the mixture as long as the volumetric ratio of oxygen to carbon dioxide in the mixture is maintained at 11 to 8. Theoretical calculations based on Wilke's equation show that when the ratio of hydrogen to oxygen is 2 to 1 in a ternary mixture of hydrogen–nitrogen–oxygen, the viscosity of the mixture at a particular temperature is constant irrespective of the percentage volume of nitrogen present. The viscosity and molecular weight of nitrous oxide is equal to that of carbon dioxide. It is possible to replace carbon dioxide by nitrous oxide in a mixture of oxygen–nitrogen–carbon dioxide without affecting the final viscosity of the ternary mixture. Similarly, carbon monoxide can replace nitrogen in a mixture of hydrogen–nitrogen–oxygen. Author

N68-16227*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
DYNAMIC PRESSURE LIMITS FOR FLAT PLATES AS RELATED TO NUCLEAR FUEL ELEMENTS
Roger L. Smith Washington Feb. 1968 29 p refs
(NASA-TN-D-4417) CFSTI: HC $3.00/MF $0.65 CSCL 18J

Tests with air or helium flowing over single flat plates were performed at room temperature to determine the values of dynamic pressure required to cause plate failure. Failure was defined as a deflection greater than 0.010 inch (0.0254 mm). The ranges of the plate dimensions used are given. The plate materials selected were lead, aluminum, copper, and steel, which provide ranges of Young's modulus of elasticity from 2×10^6 to 30×10^6 psi (1.38×10^6 to 20.7×10^6 N/cm^2), and of Poisson's ratio from 0.288 to 0.42. Gas density varied from 0.025 to 1.0 pound per cubic foot (0.4 to 16 kg/m^3). The experimental results were compared with an existing theoretical analysis which predicts dynamic pressure for sudden, complete plate collapse. The experimental results agree with the theoretical prediction for the effect of the material properties, but disagree with the prediction for the effect of the plate and flow-channel dimensions. The large amount of experimental data scatter and the disagreement of these data with the theoretical prediction may be caused by leading-edge effect, flutter, turbulence, or other unknown factors. Author

N68-16238# Polytechnic Inst. of Brooklyn, N. Y. Dept. of Aerospace Engineering and Applied Mechanics.
IMPURITY PHOTOIONIZATION THEORY OF PRECURSORS Research Report
Daniel S. Wilson and Tony C. Lin Oct. 1967 50 p refs
(Contract Nonr-839(38); ARPA Order 529)
(PIBAL-1006; AD-663145)

An extension of Wetzels theory is proposed to explain electron precursor phenomena in pressure driven shock tubes. The theory is based on the assumption which has been experimentally verified, that radiation from the hot gas behind the shock front is responsible for the precursor effect. A point radiator, located at the shock front and moving with the shock velocity, is assumed. It is shown that this radiator can be idealized by a black body. The precursor electron density is derived from a one-step photoionization of the impurities present in the driven gas. As an application of the theory, precursor profiles are calculated for an H2 is varied from 2 to 75 microns Hg. The temperature behind the shock is assumed to be 11,000K. Author (TAB)

N68-16368*# New York Univ., N. Y. School of Engineering and Science.
EFFECTS OF NON-GREY GAS BEHAVIOR AND NONEQUILIBRIUM IONIZATION IN RADIATING SHOCK LAYERS
Ping Cheng Nov. 1967 36 p refs
(Grant NGR-33-016-067)
(NASA-CR-92990; F-67-7) CFSTI: HC $3.00/MF $0.65 CSCL 20D

An analysis of the effects of nonequilibrium ionization and non-grey radiation in hypersonic shock layers is formulated. Two

essentially distinct models are used: (1) a Ferrari–Clarke model for photoionization in an effectively "grey" gas; and (2) a non-grey step function model for radiative nonequilibrium. Some difficulties associated with the numerical solution of the resulting two-point boundary value problems are discussed. Author

N68-16372# Massachusetts Inst. of Tech., Cambridge. Engineering Projects Lab.
ANALYTICAL AND EXPERIMENTAL INVESTIGATION OF FLOW OSCILLATIONS IN A CLOSED LOOP WITH TRANSPARENT, PARALLEL, VERTICAL HEATED CHANNELS Summary Report, 1 Feb. 1965–31 Oct. 1967
S. W. Gouse, Jr. 30 Nov. 1967 5 p refs
(Contract Nonr-3963(15))
(Rept.-1; AD-663289)

The purpose of the research program was to conduct an analytical and experimental investigation of flow oscillations 9in a closed-loop with transparent, parallel, vertical, heated channels. Two masters theses, two papers and one technical report were published. Two doctoral theses are in progress. In addition, work on this program provided substantial contributions of basic information to both a special summer session and a regular graduate course on two-phase gas-liquid flow phenomena. Author (TAB)

N68-16390# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
ANALYTICAL SOLUTIONS TO EDDY-CURRENT PROBE COIL PROBLEMS
C. V. Dodd and W. E. Deeds (Tenn. Univ., Knoxville) Nov. 1967 41 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1987) CFSTI: HC $3.00/MF $0.65

Solutions have been obtained for axially symmetric eddy-current problems in two configurations of wide applicability. In both cases the eddy currents are assumed to be produced by a circular coil of rectangular cross section, driven by a constant amplitude alternating current. One solution is for a coil above a semi-infinite conducting slab with a plane surface, covered with a uniform layer of another conductor. This solution includes the special cases of a coil above a single infinite plane conductor or above a sheet of finite thickness, as well as the case of one metal clad on another. The other solution is for a coil surrounding an infinitely long circular conducting rod with a uniformly thick coating of another conductor. This includes the special cases of a coil around a conducting tube or rod, as well as one metal clad on a rod of another metal. The solutions are in the form of integrals of first-order Bessel functions giving the vector potential, from which the other electromagnetic quantities of interest can be obtained. The coil impedance has been calculated for the case of a coil above a two-conductor plane. The agreement between the calculated and experimental values is excellent. Author (NSA)

N68-16428*# General Dynamics/Astronautics, San Diego, Calif.
DIGITAL ANALYSIS OF LIQUID PROPELLANT SLOSHING IN MOBILE TANKS WITH ROTATIONAL SYMMETRY
D. O. Lomen 30 Nov. 1964 40 p refs
(Contract NAS8-11193)
(NASA-CR-61540; GD/A-DDE64-062) CFSTI: HC $3.00/MF $0.65 CSCL 20D

Hydrodynamic forces and moments are derived for tanks possessing a longitudinal axis of symmetry. These forces and moments are given in terms of coefficients which depend only on the tank geometry. The steps used to obtain these coefficients, given the tank geometry, and the procedures used in the program check-out are explained. A description of the routines used in the program is included as well as instructions for use of the program. The output of the digital program gives the spring-mass parameters associated with the system. Author

N68-16441# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
ON THE INITIAL DEVELOPMENT OF INCOMPRESSIBLE FLOW PAST AN IMPULSIVELY STARTED SPHERE
R. Chow Jan. 1968 24 p refs
(RE-317)

The initial development of flow about an impulsively started sphere (Boltze's problem) is investigated by the method of matched asymptotic expansions in terms of a small parameter, which is the reciprocal Reynolds number. The boundary layer and the induced flow are studied in a systematic way so that the displacement effect due to the boundary layer growth, ignored in Boltze's original study, is included in the present investigation. A composite solution for the flow field, uniformly valid up to $O(\epsilon^2)$, is obtained in closed form. The condition for flow separation time is derived as a function of the Reynolds number. The results indicate that the separation time shows stronger Reynolds number dependence for an impulsively started sphere than for a cylinder. Author

N68-16447*# National Bureau of Standards, Boulder, Colo. Cryogenics Div.
TWO-PHASE (LIQUID-VAPOR), MASS-LIMITING FLOW WITH HYDROGEN AND NITROGEN
J. A. Brennan, D. K. Edmonds, and R. V. Smith 30 Jan. 1968 24 p refs
(NASA Order R-45)
(NASA-CR-92722) GPO: HC $0.25; CFSTI: MF $0.65 CSCL 20D

Experimental data on critical (choked) mass flow in a constant area test section are presented. The data are compared to some simple analytical models which have been recommended for design purposes. The data show the same general behavior as that reported for other noncryogenic fluids. Author

N68-16482*# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
RESEARCH ON GAS-SURFACE INTERACTIONS 1966–67. PART 2: NUMERICAL EXPERIMENTS ON SCATTERING OF NOBLE GASES FROM SINGLE CRYSTAL SILVER
R. A. Oman Nov. 1967 50 p refs
(Contract NASw-1461)
(NASA-CR-92704; RE-306, Pt. 2) CFSTI: HC $3.00/MF $0.65 CSCL 20D

Most of the three dimensional numerical experiments are for neon on the fcc (111) surface, but cases of helium and argon on (111) and neon on (100) are included. Energies include effusive molecular beams from 300° K to 45,000° K. Interaction parameters describing mean energy and momentum exchanges and spatially resolved flux in the incident plane are given, with sample out-of-plane fluxes and some data on spatially resolved energy. The results give trapping probabilities much greater than inferred and flux patterns significantly broader than encountered in the experiments for the few cases that can be compared directly. The neon trends with increasing energy are similar to experiments for xenon, with new effects appearing for energies higher than the experiments. The trends of the hard cube theory are shown at low incident energy, and the expected hard sphere limit behavior is observed at very high incident energy. Author

N68-16494# Lehigh Univ., Bethlehem, Pa. Inst. of Research.
FORCES ON A SMALL SPHERE IN A GASEOUS FIELD WITH WEAK GRADIENTS CALCULATED BY THE CORRECTED STRESS EQUATION Technical Report, Apr. 1964–Mar. 1967
Nobunori Oshima 5 Jan. 1968 49 p refs
(Grants NSF GP-2366; NSF GP-5393)
(TR-21)

The retardation coefficients of a small sphere in a weak inhomogeneous gaseous field are calculated. The effect of non-uniformity of the flow on the particle is classified into three

kinds of force which are proportional to the velocity, the thermal gradient and the pressure gradient of the fluid far from the particle. In order to satisfy the kinetic boundary conditions on the particle surface, the simplest equation based on a careful formulation of mass, momentum and energy fluxes is proposed, and the three coefficients are obtained as functions of the mean free path–particle radius ratio. Author

N68-16532# Brown Univ., Providence, R. I. Engineering Div.
LAMINAR BOUNDARY LAYER CONTROL BY COMBINED BLOWING AND SUCTION IN THE PRESENCE OF ROUGHNESS
G. F. Anderson, S. P. Sutera, and V. S. Murthy Oct. 1967 72 p refs Prepared for Pa. State Univ.
(WT-51)

The feasibility of maintaining a fully laminar boundary layer on a given two-dimensional body by means of combined blowing and suction and the effectiveness of blowing for increasing the boundary layer's tolerance to roughness are investigated theoretically. The potential flow past the body is determined by using a suitably selected source distribution and then refining the body obtained from this selection by means of slender body techniques. The boundary-layer calculations are then made for various blowing rates at the stagnation point. The calculations indicate that the combination of suction, applied to maintain a laminar boundary layer, and blowing near the stagnation point, to improve the tolerance of the laminar boundary to roughness, can substantially reduce the skin friction of bodies operating at high Reynolds numbers. Author

N68-16549# Tokyo Univ. (Japan). Inst. of Space and Aeronautical Science.
SHOCK WAVE AND VISCOUS LAYER STRUCTURE IN A RAREFIED HYPERSONIC FLOW NEAR THE LEADING EDGE OF A SHARP FLAT PLATE
Hakuro Oguchi Dec. 1967 22 p refs
(ISAS-418, V. 32, No. 11; Rept.-418)

An analysis is presented for the merged layer regime of a hypersonic flow past a semi-infinite flat plate with a sharp leading edge. The analysis is based on the continuum flow theory. The viscous layer solution which is similar to one previously derived by the author is found to patch with the shock-wave-structure solution. The density ratio across the shock and the ratio of shock thickness to viscous layer thickness are evaluated. The results indicate a consistent agreement with experimental data obtained by others concerning flow detail. Author

N68-16554# Centre National de la Recherche Scientifique, Meudon (France). Lab. d'Aerothermique.
STUDY OF THE LAMINAR FAR WAKES. PART 2: AXISYMMETRIC FLOW [ETUDE DU SILLAGE LAMINAIRE LOINTAIN. DEUXIEME PARTIE: ECOULEMENT DE REVOLUTION]
Henri Viviand Jul. 1967 57 p refs In FRENCH
(Rept.-67-7) CFSTI: HC $3.00/MF $0.65

The bases of calculation of the laminar far wakes are as follows: the Prandtl number is constant, but not necessarily equal to one; viscosity varies as the pure power of the temperature; there is an external pressure gradient, imposed by the non-viscous flow and assumed to be known. Generalizing from earlier work on the far wake with axisymmetric flow, the speed and the enthalpy are written in the form of asymptotic developments, valid at a great distance from the obstacle; the general form is established and the first terms of these developments are calculated. ESRO

N68-16561# Nationaal Lucht-en Ruimtevaartlaboratorium, Amsterdam (Netherlands).
ON THE STABILITY OF TWO-DIMENSIONAL TRANSONIC FLOWS
B. M. Spee 18 Oct. 1967 13 p refs
(NLR-TN-T-182) CFSTI: HC $3.00/MF $0.65

The stability of two-dimensional transonic flows with respect to unsteady disturbances generated in the subsonic flow downstream of the local supersonic region has been investigated. It is shown that transonic potential flows around aerofoils are stable when the maximum local Mach number does not exceed the value $M = 2/(3-\gamma)^{1/2}$. Author (ESRO)

N68-16593# National Research Council of Canada, Ottawa (Ontario).
A FORM OF THE EQUATION OF STATE OF A REAL GAS [O FORME URAVNENIYA SOSTOYANIYA REAL'NOGO GAZA]
P. M. Kessel'man 1967 11 p refs Transl. into ENGLISH from Inzh.-Fiz. Zh. (Moscow), v. 2, no. 1, 1959 p 68–75
(NRC-TT-1282) CFSTI: HC $3.00/MF $0.65

Proceeding from the general Mayer theory, a theoretical form of the equation of state is established. Equations of state put into this form may be applied in practice for calculating thermodynamic properties of gases. Author

N68-16634*# Tennessee Univ., Knoxville. Dept. of Engineering Mechanics.
DYNAMICS OF GAS BUBBLES IN AN OSCILLATING PRESSURE FIELD Annual Report, Jul. 1965–Aug. 1966
C. J. Remenyik, S. S. Douglass, W. B. Merrill, and F. N. Peebles 30 Aug. 1966 101 p refs
(Contract NAS8-20152)
(NASA-CR-61559; EM-66-8-3) CFSTI: HC $3.00/MF $0.65 CSCL 20D

The behavior of oscillated liquid columns was investigated. The theory was derived from basic force-momentum relations for nonviscous and viscous fluids. The theory encompasses resonance effects, large bubble effects within a tank, and the effects of tank structure and vibrating mechanism. The analysis was extended to viscous liquids and the effect of viscosity on the stabilization of single bubbles was shown. Experiments were concerned with identifying the mechanisms by which bubbles are produced and clusters developed in the liquid, establishing the dependence of these mechanisms on the frequency and amplitude of the forced oscillations; viscosity, density, temperature, and pressure of the liquid; the concentration of dissolved gases in the liquid; the dynamic deformations and structural properties of the container; and the responses of the vibration exciter system to the frequency characteristics of the liquid filled container. The behavior of the liquid is found to be controlled by a strong feedback mechanism involving liquid, cluster, and container. Author

N68-16653* Electro-Optical Systems, Inc., Pasadena, Calif.
ZERO-G LIQUID STUDIES: CRITICAL STATE AND DROP DYNAMICS Quarterly Report, Dec. 21, 1966–Mar. 20, 1967
F. Barcatta 5 Apr. 1967 35 p refs
(Contract NAS8-21012)
(NASA-CR-61553; EOS-7170-Q-1; QR-1) CFSTI: $3.00 CSCL 20D

Preliminary engineering studies are being conducted to design zero-g fluid experiments onboard the Apollo/LEM spacecraft in earth orbit, in order to determine the behavior of fluids at near-critical state, and the dynamics of liquid drops under weightless conditions. Nine critical experiments are proposed to measure a value of a property at the critical state (if it is finite), and to ascertain how the property changes with state in regions close to the critical state. These include density, visualization, light scattering, refractive index, inelastic light scattering, acoustic absorption, viscosity, thermal conductivity, and heat capacity. The primary objectives and the characteristics of each experiment are discussed. Consideration is also given to the design development of a test chamber. A liquid drop dynamics experiment definition matrix is included to illustrate the many possible experiments and the various experimental configurations.

Four principal areas were selected for further study: two-drop collisions, vortices, single drops with oscillation and spin, and many-droplet kinetics. M.G.J.

N68-16758# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EXPERIMENTAL INVESTIGATION OF THE INFLUENCE OF THERMODYNAMIC PROPERTIES OF LIQUID ON CAVITATION PHENOMENA
N. S. Yershov, B. I. Borovskiy, and V. V. Yakimov 31 Mar. 1967 14 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Aviats. Tekh. (Kazan), no. 2, 1966 p 130–136
(FTD-MT-67-40; AD-663353)

It was proposed in previously published work that the effect of the properties of a liquid on cavitation phenomena can be evaluated in terms of the number B, which is the ratio of the volume of vapor formed during cavitation to the volume of the liquid flow. The experiments described in the article were carried out in a Venturi cavitation tube. The temperature of the water was varied from 290 to 359K, and the temperature of the alcohol from 293 to 332K. The calculations show that, with these changes in temperature, the B number changes 30 times for water and approximately 4 times for alcohol. The article includes a sketch of the cavitation tube. TAB

N68-16768 Association Francaise des Ingenieurs et Techniciens de l'Aeronautique et de l'Espace, Paris.
EXPERIMENTAL CALCULATION OF THE VELOCITY RANGE FOR THE STUDY OF SOME TRANSONIC OUTFLOW PROBLEMS [DETERMINATION EXPERIMENTALE DU CHAMP DE VITESSE POUR L'ETUDE DE QUELQUES PROBLEMES D'ECOULEMENT TRANSSONIQUE]
A. Dyment and G. Gontier 10 Nov. 1967 17 p refs In FRENCH Presented at the App. Aerodyn. 4th Colloq. at A.F.I.T.A.E., 8–10 Nov. 1967

The capabilities and characteristics of the transonic wind tunnel are described, and several examples are presented to illustrate the results obtained. Transl. by M.G.J.

N68-16772# Pennsylvania State Univ., University Park. Dept. of Mechanical Engineering.
AN EXPERIMENTAL INVESTIGATION OF THE SMALL SCALE STRUCTURE OF TURBULENCE IN A CURVED MIXING LAYER
John C. Wyngaard (Ph.D. Thesis) Sep. 1967 117 p refs
(PB-176165) CFSTI: HC $3.00/MF $0.65

All the measurements in the study were made at a primary jet speed of 34 ft/sec, compared to the 150 ft/sec of the original study of Margolis that found production and transport were in balance, and dissipation was negligible. In this work it was found that production and dissipation were nearly in balance, while transport and advection were smaller but not negligible. It was concluded that the original idea of the nature of turbulent energy balances was incorrect and that the energy budgets of the curved mixing layer and the free convection layer of the atmosphere do not have quantitative similarity. In the free convection layer, turbulent transport and production are in balance, and dissipation is negligible; in the curved mixing layer, dissipation essentially balances production, and these are the dominant terms. It appears then that curvature does not affect the small-scale structure of turbulence in a mixing layer. It does influence the large-scale motion, however; this is shown by the large values of turbulent intensity and Reynolds stress in the unstable case. Author

N68-16795# Toulouse Univ. (France).
HYDRODYNAMIC MEASURES OF UNSTATIONARY COEFFICIENTS [MESURES HYDRODYNAMIQUES DE COEFFICIENTS INSTATIONNAIRES]
C. Beth, A. Claria, J. M. Fourtanier, and F. Sananes 10 Nov. 1967 37 p refs In FRENCH Presented at the App. Aerodyn. 4th Colloq. at A.F.I.T.A.E., 8–10 Nov. 1967

To obtain data on effectively launching a missile in water, tests were conducted to determine the hydrodynamic characteristics in a stationary and unstationary regime. Details are given on the towing installation in the canal, the oscillation drive mechanisms, and the model. The methods used to directly record the measurements are described, and various procedures are given for evaluating the results. It was concluded that the tests were particularly effective in determining the coefficients of pitching moment and of normal force, which are difficult to measure in air. Transl. by M.G.J.

N68-16814 Poitiers Univ. (France).
PROJECT STUDY OF CAVITATION AND SUBCAVITATION FLOW OF LONGITUDINAL HYDRODYNAMIC DERIVATIONS [PROJET D'ETUDE EN ENCOULEMENT SUBCAVITANT ET CAVITANT DES DERIVEES HYDRODYNAMIQUES LONGITUDINALES]
P. Bry 10 Nov. 1967 29 p refs In FRENCH Presented at the App. Aerodyn. 4th Colloq. at A.F.I.T.A.E., 8–10 Nov. 1967

Experimental studies were conducted to determine the capabilities of a system for accurately measuring the hydrodynamic derivatives of wing struts at various levels of immersion and in conditions of subcavitation and cavitation flow. Important measurements are listed in sequence, and the particular problems pertaining to each are examined. Consideration is given to the infinite incompressible fluid, and to a supercavitating fluid with a free surface. Experimental and theoretical results are compared, and it was concluded that the experimental results are inferior to the theoretical due to the effects of depth and of linearization. Transl. by M.G.J.

N68-16819# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
EXPERIMENTAL STUDY OF REFLECTED-SHOCK TUNNEL FLOWS IN THE EQUILIBRIUM INTERFACE REGION
M. G. Dunn Jan. 1968 34 p refs
(CAL-AM-1702-A-1)

Studies have been conducted in the shock tube and in the conical nozzle of a reflected-shock tunnel to ascertain the range of validity of the equilibrium interface concept as used in shock-tunnel operation. The test gas in these experiments was either air or nitrogen, and the driver gas was either hydrogen or helium. The driven-tube initial pressure was held fixed at 10.0 mm Hg and the Mach number varied from 7.3 to 12.2. The composition of the driver gas was found to be particularly important. With hydrogen used as the driver gas the increased enthalpy levels implied by the pressure data in the equilibrium interface region were apparently not achieved. With helium used as the driver gas the results suggested that the equilibrium-interface concept may be valid at substantially over-tailored incident-shock Mach numbers. Author

N68-16839*# National Aeronautics and Space Administration, Washington, D. C.
STUDIES IN PHYSICAL GAS DYNAMICS
A. S. Predvoditelev, ed. Feb. 1968 267 p refs Transl. into ENGLISH of the book "Issledovaniya po Fizicheskoy Gazodinamike" Moscow, Nauka Press, 1966
(NASA-TT-F-505) CFSTI: HC $3.00/MF $0.65 CSCL 20D

A collection of articles is presented on basic research in physical gas dynamics, with emphasis placed on molecular band spectra, shock tube studies, and interactions between diatomic molecules. For individual titles, see N68-16840 through N68-16867.

N68-16856*# National Aeronautics and Space Administration, Washington, D. C.
NONISENTROPIC NONEQUILIBRIUM FLOW OF A GAS THROUGH A NOZZLE WITH FRICTION AND HEAT EXCHANGE TAKEN INTO ACCOUNT

A. S. Pleshanov and P. A. Kon'kov *In its* Studies in Phys. Gas Dyn. Feb. 1968 p 148–171 refs (See N68-16839 07-12)

Described are hydrodynamic equations for calculating nonisentropic nonequilibrium flow of a gas through a nozzle, which consider friction and heat exchange effects on flow. S.C.W.

N68-16857*# National Aeronautics and Space Administration, Washington, D. C.

AN EXPERIMENTAL INVESTIGATION OF THE ESCAPE OF DISSOCIATED GASES THROUGH SUPERSONIC NOZZLES

V. P. Ionov and G. N. Nikolayev *In its* Studies in Phys. Gas Dyn. Feb. 1968 p 172–180 refs (See N68-16839 07-12)

Preliminary experiments designed to study the flow of dissociated gases (O_2, N_2, CO_2) through supersonic nozzles in a shock tube having a nozzle are reported. Experimental values of the M number of the flow for various ratios of the areas of the exit section to the critical section were derived by a method of visualization of the flow around a half-wedge placed at the nozzle cutoff. The M numbers of the flow from the experiment were compared with calculated values on the simplest hypothesis of equilibrium isentropic gas flow without taking into account the viscosity and heat conductivity of the gas and heat losses in the nozzle wall. In the flow regimes studied, a noticeable deflection from the isentropic flow was observed for oxygen and carbon dioxide. Approximate estimates of errors were made in calculating the isentropic flow by virtue of the inaccuracy in determining the gas parameters in the reservoir and deviations from the isentropic nature due to heat exchange and friction at the nozzle walls. Considering corrections for oxygen did not aid in coordinating calculated and experimental values of the M number, which were much higher than the rated values. It is concluded that this factor qualitatively indicates the possibility of deviation of the flow from equilibrium at the nozzle exit. S.C.W.

N68-16858*# National Aeronautics and Space Administration, Washington, D. C.

CALCULATION OF THE RECOMBINATION RATE CONSTANTS OF DIATOMIC GASES ACCORDING TO THE MACH NUMBER OF THE FLOW AT THE EXIT OF A SUPERSONIC NOZZLE

G. N. Nikolayev *In its* Studies in Phys. Gas Dyn. Feb. 1968 p 181–185 refs (See N68-16839 07-12)

A calculation based on the supposition concerning the sudden freezing of the chemical state of a gas was performed in a quasi-one-dimensional adiabatic approximation of the nonequilibrium expansion of partially dissociated oxygen and nitrogen in a supersonic nozzle. The relationship between the recombination rate constant of the gas and the distribution of the Mach number along the nozzle length with a change of the nozzle cross sectional area was analyzed using the hyperbolic law. The expediency of applying the proposed method was demonstrated in determinations of the recombination rate constant of a dissociated diatomic gas with respect to the measured values of the Mach number of the flow leaving a supersonic nozzle. S.C.W.

N68-16861*# National Aeronautics and Space Administration, Washington, D. C.

CALCULATION OF THE ONSET TIME OF EQUILIBRIUM DISSOCIATION ON THE BASIS OF EXPERIMENTAL DATA CONCERNING THE NONSTATIONARY PROPAGATION OF A REFLECTED SHOCK WAVE

T. V. Bazhenova *In its* Studies in Phys. Gas Dyn. Feb. 1968 p 199–202 refs (See N68-16839 07-12)

According to previous investigations, the velocity of a shock wave in CO_2 reflected from the end of a shock tube (at M numbers of the shock wave ≈ 8 to 11 and $p_0 = 12$ mm Hg) has values which correspond to frozen dissociation of molecules, and assume equilibrium values 7 to 30 μ sec after reflection. On the basis of these data, the dissociation relaxation times of carbon dioxide at 4,000 to 6,000°K were estimated. Calculations were based on the assumption that the velocity of a reflected wave takes equilibrium values in a time interval equal to the sum of the dissociation relaxation time and the time of signal propagation at the velocity of sound from the end of the tube to the front of the reflected wave. An expression derived in a previous study which relates the relaxation time to the time of approach of the velocity of the shock wave to the equilibrium value was applied to results of measurements of the onset time of the equilibrium velocity of a reflected shock wave in carbon dioxide. Results indicate that the dissociation relaxation time was 1.6 times less than the onset time of the equilibrium velocity of the shock wave. The dependance of the onset time of equilibrium dissociation on the temperature of the gas behind a reflected shock wave was also calculated. S.C.W.

N68-16862*# National Aeronautics and Space Administration, Washington, D. C.

PECULIARITIES OF MACH REFLECTION OF SHOCK WAVES MOVING IN CARBON DIOXIDE AND NITROGEN AT VELOCITIES ON THE ORDER OF 2,000 M/SEC

L. G. Gvozdeva and O. A. Predvoditeleva *In its* Studies in Phys. Gas Dyn. Feb. 1968 p 203–212 refs (See N68-16839 07-12)

Peculiarities of Mach reflection of shock waves for Mach numbers $M_0 > 5$ were studied in nitrogen and carbon dioxide. The following peculiarities which were obtained using a Toplar device and a high speed camera and which distinguish pictures obtained at $M_0 > 5$ from those obtained at low M numbers: (1) A second triple point appeared during reflection. The reflected wave in carbon dioxide being located below the trajectory of motion of the triple point, while the reflected wave in nitrogen was located above this trajectory. (2) Instability of the contact discontinuity was sharply expressed. The contact discontinuity in nitrogen envolved into a vortex, and sharp fluctuations of the contact discontinuity were visible in CO_2 at the vertex near the triple point. (3) If the Mach stem in N_2 was straight and perpendicular to the wall, the stem in CO_2 had a noticeable break. Interpretation of experiments indicated that the triple point moved on a straight line inclined at a constant angle to the wedge surface. It was further found that using the value of the angles it was possible to calculate the angles near the triple point according to the three shock theory. The angles were calculated by the shock polar method in a coordinate system connected with the triple point. Values of a three shock configuration for CO_2 and N_2 are given. The three shock theory provided good agreement for CO_2 under the assumption concerning the excitation of vibrations of gas molecules. S.C.W.

N68-16897*# IIT Research Inst., Chicago, Ill.

EXPERIMENTAL INVESTIGATION OF TURBULENCE IN THE MIXING REGION BETWEEN COAXIAL STREAMS

Thomas S. Zawacki and Herbert Weinstein Washington NASA Feb. 1968 145 p refs

(Grant NsG-694)

(NASA-CR-959) CFSTI: HC $3.00/MF $0.65 CSCL 20D

An experimental study is made of axially symmetric, turbulent, incompressible, coflowing streams. Hot wire anemometry techniques are used to make measurements in three systems, the homogeneous system with a resultant density ratio of 1, and two heterogeneous systems, one with an inner to outer stream density ratio of 4 to 1, and another with an inner to outer stream density ratio of 7 to 1. The outer stream velocity was varied from 12 to 50 ft/sec, and the inner stream was changed to provide outer stream to inner stream velocity ratios of from 1 to 40. Data is presented for the relative axial turbulence intensity, the relative radial turbulence intensity, and the turbulent shear stress for various velocity ratios in the homogeneous system, in both the initial mixing region and the downstream or similar region. The maximum relative turbulence intensity found was 0.40. For the 4 to 1 density case, data is presented for average velocity, the average density, and the relative velocity turbulence intensity for various velocity ratios in both the

initial mixing region and the downstream or similar region. The maximum relative turbulence intensity found was 0.70. Average density and velocity profiles are presented for the 7 to 1 density ratio in the near and downstream regions. Author

N68-16921# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.

PERIODIC BOUNDARY LAYER FLOWS OVER A FLAT PLATE. PART 3: WITH DISTURBANCE BARS

V. O'Brien Aug. 1967 108 p refs

(Contract NOw-62-0604-c)

(TG-944; AD-663264)

Parallel periodic flows created in viscous fluids by an oscillating flat plate were disturbed by placing bars on the plate. The local regions of nonparallel flow were investigated experimentally using dye and neutral density particles as tracers. The flows were also studied theoretically by numerical solution of the Stokes equation. Though these solutions are approximate (because they neglect the nonlinear inertia term), the calculations show reasonable agreement with the experimental data at small similarity parameter. The changing character of the separated flow with height of the rectangular disturbance bar is clearly indicated. At moderate similarity parameter with large bars, there are discrepancies attributable to the neglected term, while at still higher similarity parameter an intermittency appears that may be related to the stability of these unsteady viscous flows. A number of related flows were also calculated for comparison. Author (TAB)

N68-16998*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

PERFORMANCE STUDY OF ROTATING GAS JET GENERATOR FOR STRONG TRAVELING TRANSVERSE ACOUSTIC MODES

Marcus F. Heidmann Washington Feb. 1968 37 p refs

(NASA-TN-D-4380) CFSTI: HC $3.00/MF $0.65 CSCL 21E

An experimental investigation is made of a traveling transverse acoustic mode generator which utilizes a rotating gas jet as an energy source. The gas jet is radially alined and located at the center of a short cylindrical cavity with an exhaust port at the center of one end plate. Jet rotation is varied over a range of speeds encompassing the rotational speeds of several spinning transverse acoustic modes and pressure amplitudes are measured at the circumference of the cavity. The effect of jet total pressure, jet configuration, and cavity diameter on amplitude is investigated. Pressure amplitude as a function of rotational speed for a single radial jet exhibits several conditions of resonance. One occurs when jet speed corresponds to the resonant frequency of the first transverse mode. Higher modes occur at lower rotational speeds when more than one pressure oscillation is obtained for each rotation of the jet. For all modes and jet configurations, pressure amplitudes increase with an increase in jet total pressure and flow rate. Maximum peak-to-peak pressure amplitudes for all conditions was 38 psi (2.62×10^5 N/m^2) which corresponds to a sound pressure level of 192 decibels. The wave shape at all resonant conditions was symmetrical with time about the peak pressure and appeared free of shocks. The conversion efficiency of potential jet power to acoustic power was evaluated for all resonant conditions. In general, efficiency increased with an increase in jet total pressure. A maximum efficiency of 44% was observed with a divergent nozzle. Small diameter jets in a large diameter cavity generally gave highest efficiencies; however, the result depends on jet total pressure. Two radial jets gave improved efficiencies over a single jet in generating the second transverse mode. Efficiencies for the higher modes, however, were nearly an order of magnitude lower than for the first mode for each increase in mode number. Author

N68-17000# Accademia delle Scienze di Torino (Italy).

ON THE GENERATION OF TURBULENCE IN THE BOUNDARY LAYER WITH PRESSURE GRADIENT [SULLA GENERAZIONE DELLA TURBOLENZA NELLO STRATO LIMITE CON GRADIENTE DI PRESSIONE]

Carlo Ferrari 1966 51 p refs In ITALIAN Presented at Mem. for Ennio Mattioli Meeting, 23 Feb. 1966 *Its* Ser. 4A, No. 5

(Grant AF-EOAR-63-98)

To examine the effect of positive pressure gradient on transition of laminar flow to turbulence, the boundary layer of a smooth parallel plate in an incompressible fluid was studied. The large kinematic characteristics of the boundary layer were measured in a specially-constructed pressure gradient tunnel, and fluctuations of velocity were measured as functions of time. The nature of transitions, parameters of form and exactness for the pressure gradient, and Reynolds number corresponding to turbulence were studied. Transl. by Y.S.

N68-17040 General Applied Science Labs., Inc., Westbury, N. Y.

A NUMERICAL TECHNIQUE FOR THE THREE-DIMENSIONAL BLUNT BODY PROBLEM

G. Moretti and G. Bleich 29 May 1967 83 p refs Prepared for Sandia Corp.

(GASL-TR-637)

The three-dimensional flow field around blunted bodies traveling at supersonic speed is computed using a time dependent technique. As in the two-dimensional case reported elsewhere, the problem is mathematically well posed, the technique is stable and its accuracy increases with the finess of the mesh. Values at points within the shock layer are computed by a method closely related to the Lax–Wendroff technique. The shock wave is considered as a moving discontinuity. Values at shock points and body points are computed by a four-dimensional method of characteristics. A three-dimensional flow around a blunt body is computed in 40 minutes on an IBM 7094. Full detailed examples are given. Author

N68-17050# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).

AN EXTENSION OF THE ORNSTEIN–ZERNIKE THEORY OF THE CRITICAL REGION

G. Stell Dec. 1967 9 p refs Sponsored by NSF

(TH/231)

The Ornstein-Yernike integral equation that relates a total correlation function is utilized in deriving a new relationship between the shape of critical isotherm and the range of the two-particle correlation function. L.S.

N68-17058# Atomic Energy Commission Research Establishment, Riso (Denmark). Physics Dept.

ON THE RELATION BETWEEN EULERIAN AND LAGRANGIAN AVERAGES IN THE STATISTICAL THEORY OF TURBULENCE

O. Kofoed-Hansen and C. F. Wandel (Aarhus Univ.) Jun. 1967 52 p refs

(RISO-50)

Two important types of probing of a turbulent velocity field u(r,t) are the Eulerian probings defined by dr/dt = v(v constant) and the Lagrangian probing defined by dr/dt = u(r,t). In the case of fully developed isotropic and homogeneous turbulence, explicit expressions in terms of the energy spectrum are derived for the autocorrelation coefficients and power spectra obtained by Eulerian and Lagrangian probing. The derivations given in detail are based on a statistical representation of the turbulent velocity field using the results of the equilibrium theory of turbulence. The Tailor hypothesis is verified in the limit of high probing velocities. The Hay–Pasquill conjecture relating the Lagrangian and Eulerian power spectra is obtained as an approximation to the transformation

equations. Application of the results to the theory of turbulent diffusion is indicated. Author (NSA)

N68-17105# National Bureau of Standards, Boulder, Colo. Inst. of Materials Research.
CRITICAL FLOW IN AN ANNULAR VENTURI
R. V. Smith, L. B. Cousins (AERE), and G. F. Hewitt (AERE) [1967] 23 p refs Presented at the Symp., Eindhoven, Netherlands, Sep. 1967

Preliminary experimental and analytical work are reported for airwater flow in a converging-diverging annular venturi with critical and near-critical conditions at the throat. In all cases of critical flow, a pressure discontinuity (shock) occurred in the diverging portion since the discharge pressure was too high for complete expansion. Visual and photographic observations of the flow were possible since the venturi consisted of a formed solid core in a straight transparent acrylic resin tube. The core could be moved axially to allow accurate measurement of pressure profiles. Comparison of the results with the case of ideal gas critical flow, indicates that the presence of the liquid phase has surprisingly little effect on the critical pressure ratios. Author

N68-17107# Naval Ship Research and Development Center, Washington, D. C. Hydromechanics Lab.
THE FRICTIONAL RESISTANCE AND VELOCITY SIMILARITY LAWS OF DRAG-REDUCING DILUTE POLYMER SOLUTIONS Final Report
Paul S. Granville Sep. 1967 43 p refs
(NSRDC-2502; AD-663134)

The velocity similarity laws of shear flows are developed for dragreducing dilute polymer solutions. Relations for boundary-layer parameters and frictional resistance formulas of the logarithmic type are derived for pipe flow and for flat plates in parallel flow. Author (TAB)

N68-17155# Royal Aircraft Establishment, Farnborough (England).
A DIAGRAM FOR THE OPTIMAL DESIGN OF A SHOCK SYSTEM IN AXISYMMETRIC SUPERSONIC DIFFUSERS WITH EXTERNAL COMPRESSION [DIAGRAMMA DLYA OPTIMAL'NOGO PROEKTIROVANIYA SISTEMY SKACHKOV V OSESIMMETRICHNYKH SVERKHZVUKOVYKH DIFFUZORAKH S VNESHNIM SZHATIEM]
A. P. Pudoveev Nov. 1967 6 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Aviats. Tekh. (Kazan), no. 2, 1966 p 151–153
(RAE-LIB-TRANS-1259) CFSTI: HC $3.00/MF $0.65

The diagram, constructed from optimal solution, enables the designer to select the optimal geometry of the central body of the diffuser and to determine the flow parameters. The diagram and its use are described. N.E.N.

N68-17217# Aerodynamische Versuchsanstalt, Gottingen (West Germany). Abteilung Raumfahrt–Aerodynamik.
AN EXPERIMENTAL INVESTIGATION OF THE LOW DENSITY HYPERSONIC NOZZLE FLOW WITH VIBRATIONAL RELAXATION [EXPERIMENTELLE UNTERSUCHUNGEN UEBER DIE HYPERSONISCHE DUESENTROEMUNG BEI SEHR GERINGER GASDICHTE MIT SCHWINGUNGSRELAXATION]
G. Koppenwallner, K. Buetefisch, and K. Kienappel Oct. 1967 41 p refs In GERMAN; ENGLISH summary
(DLR-FB-67-69; DK-533.59; DK-533.6.011.8; DK-533.7)

The determination of the expansion of diatomic gases in hypersonic nozzles becomes difficult because there are relaxation phenomena between the different degrees of freedom of the molecules. The theory of vibrational relaxation is discussed and a method is presented to calculate the freezing temperature of vibration in the subsonic part of a nozzle. In addition to the usual measurements of stagnation pressure, stagnation temperature, and Pitot pressure, the determination of the vibrational temperature by the electron beam technique and of the flow velocity by a mass-flux probe was employed. The results and a comparison with other theoretical calculations are presented. Author

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N68-16119# National Research Council of Canada, Ottawa (Ontario).
PRINCIPLES OF GEOCRYOLOGY (PERMAFROST STUDIES). PART 2: ENGINEERING GEOCRYOLOGY. CHAPTER 10: USE OF ICE, SNOW AND FROZEN SOIL IN ENGINEERING STRUCTURES
K. F. Voitkovskii and M. M. Krylov Jan. 1967 24 p refs Transl. into ENGLISH from Akad. Nauk SSSR (Moscow), 1959 p 267–283
(NRC-TT-1267)

The construction properties of ice, snow, and frozen soil are discussed, and several conclusions are drawn as to the mechanical properties of ice as a construction material for various engineering structures. Equations are derived to express the nonlinear relationship between stresses and rate of deformation of ice. The basic design of frozen structures is discussed with emphasis on the heat balance of a structure, and the heat exchange between the structure and surrounding medium, which determines the thermal stability of the structure. Plastics properties and deformations are considered, and the rheological equation defining the stressed state of an ice structure as a whole is presented. Three methods of constructing with ice are given: (1) pouring water intermittently over a temporary falsework, (2) mixed method, and (3) use of prismatic blocks of river, lake or pond ice. The design and operation of ice-walled storehouses is also discussed. B.S.D.

N68-16140# Douglas Aircraft Co., Inc., Huntington Beach, Calif. Missile and Space Systems Div.
ANALYSIS OF MEASUREMENTS OF MICROWAVE EMISSION FROM THE EARTH'S SURFACE AND ATMOSPHERE
H. A. Hyatt Jun. 1967 55 p refs
(Contract E-43-67(N))
(DAC-60693; PB-176239) CFSTI: HC $3.00/MF $0.65

The interpretation of microwave, radiometer measurements of the horizontal and vertical polarization components of brightness temperature at 1.35-cm and 1.90-cm wavelengths is analyzed. The analysis is based on observations made while looking down through the Earth's atmosphere onto southern California and surrounding waters. An evaluation of antenna gain patterns and analysis of the bank-angle data is included. Measured brightness temperatures of the outgoing electromagnetic energy at various nadir angles and the radiosonde data were used to compute the equivalent, smooth, ocean-surface emissivity and reflectivity at corresponding incidence angles. The calculated emissivities and reflectivities were compared with theoretical values determined from Kirchhoff's law and Fresnel equations applied to a flat, smooth, ocean surface with the same ocean-water properties. A discussion and comparison with rough-ocean-surface theory is also given. Optical depth and atmospheric water-vapor abundance were calculated from the measured birghtness temperature at 1.35-cm wavelength by assuming the atmosphere to be isothermal and the water vapor to be layered near the ocean surface. Author

N68-16151# Institut Franco-Allemand de Recherches, St. Louis (France).
THE DIFFUSE LIGHT IN THE HIGH ATMOSPHERE. PART 2: ASCENT 5 32 [DAS DIFFUSE HIMMELSLICHT IN DER HOHEN ATMOSPHAERE. TEIL 2: AUFSTIEG 5 32]

F. Roessler 2 Sep. 1966 29 p refs In GERMAN
(ISL-6/66; Pt. 2)

This evaluation of the rocket V 32 ascent in Hammaguir contains a description of the light measuring instruments and an analysis of obtained light diffusion measurement data up to 40 km height. Differentiation of the median light curve with subsequent division by air density gives the cd/kg. Obtained values are higher than Rayleigh scattering values; this discrepancy is attributed to dust particles in the air. A maximal particle density concentration is observed at 28 km heights. Author

N68-16154# Institut Franco-Allemand de Recherches, St. Louis (France).
THE DIFFUSE LIGHT IN THE HIGH ATMOSPHERE. PART 3: ASCENT 5 35 [DAS DIFFUSE HIMMELSLICHT IN DER HOHEN ATMOSPHAERE. 3. TEIL: AUFSTIEG 5 35]
F. Roessler 3 Oct. 1966 27 p refs In GERMAN
(ISL-T-22/66, Pt. 3)

Evaluation of atmospheric light diffusion measurements, obtained during rocket V 35 ascent, established the presence of dust impurities in the upper atmosphere. Especially blue light wave measurements gave precise dust registrations up to 80 km height. The presence of a dust belt in 20 km heights was confirmed and found to be much wider than observed during earlier rocket flights. There is also a possibility that another weaker dust belt exists at 50 km height. Author

N68-16205# National Center for Atmospheric Research, Boulder, Colo.
PROCEEDINGS OF THE ATMOSPHERIC RESEARCH AIRCRAFT INSTRUMENTATION WORKSHOP AND SYMPOSIUM
Jul. 1967 185 p refs Presented at Oklahoma City, 17–18 Nov. 1966
(NCAR-TN-29; PB-175777) CFSTI: HC $3.00/MF $0.65

Conference papers and the ensuing discussions are presented for sessions on the measurement of air motion, cloud physics and kinematics, and the data handling aspects of airborne meteorological research. In dealing with the measurement of air motions, instrumentation techniques and accuracies are described, and the navigation problems involved in maintaining the complex flight paths required are discussed. In discussion cloud physics and kinematics, meso- and micro-meteorological cloud parameters, temperature and particle sampling techniques, humidity and water content, atmospheric electric parameters, cloud turbulence, and airborne radar sounding are covered. Real time telemetry and data processing techniques applicable to airborne meteorological research, and recent developments in recording techniques are described. E.J.S.

N68-16207# Instituto Geografico y Catastral, Madrid (Spain).
RAPID VARIATIONS OF THE TERRESTRIAL MAGNETIC FIELD [VARIACIONES RAPIDAS DEL CAMPO MAGNETICO TERRESTRE]
Luis de Miguel 1967 30 p ref In SPANISH

A study is presented of two types of rapid variations of the geomagnetic field, namely, continuous pulses and pulse trains. The first are pulsations of a short period, with frequencies ranging from 10 to 40 seconds that are produced in the first hours of the morning and are maintained with variable intensity for several hours. The pulse trains, on the other hand, have a larger period, have frequencies of 50 to 90 seconds, and are of shorter duration, around 30 minutes. At times they appear isolated with a fairly regular periodic character, while at other times they are accompanied by storms at their start, being therefore more irregular. These two types of rapid variations are described in detail along with examples and a theoretical interpretation of their origin. Transl. by R.N.A.

N68-16234# Instituto Geografico y Castastral, Madrid (Spain).
IONOSPHERIC ABSORPTION [ABSORCION IONOSFERICA]
Luis de Miguel 1967 16 p In SPANISH

An investigation is made of absorption in the lower layers of the ionosphere. The discussion covers the determination of an ion in the presence of an electromagnetic field, the effect of the geomagnetic field on the movements of electrons, and oblique propagation. Two methods of measuring absorption, the method of impulses and the continuous wave method, are described. The principle of the riometer and its advantages over the other two methods of measuring absorption are discussed. Factors causing variations in ionospheric absorption are considered.
Transl. by R.N.A.

N68-16277*# Volt Technical Corp., Washington, D. C.
ESTIMATE OF THE CONCENTRATION OF NEGATIVE IONS IN THE D REGION OF THE IONOSPHERE
G. S. Ivanov-Kholodnyy Greenbelt, Md. NASA. Goddard Space Flight Center 8 Feb. 1968 5 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, Geofizika (Moscow), v. 177, no. 6, 1967 p 1328–1329
(Contract NAS5-12487)
(NASA-CR-92708; ST-AI-10670) CFSTI: HC $3.00/MF $0.65 CSCL 04A

An estimate is made of the concentration of negative ions in the D-region of the ionosphere by way of evaluation of the ratio $\iota^- = n_i^-/n_e$ starting from the ionospheric data on the effective recombination coefficient. Author

N68-16317 Joint Publications Research Service, Washington, D. C.
BIBLIOGRAPHY OF SOVIET UPPER ATMOSPHERES AND OUTER SPACE STUDIES
13 Feb. 1968 48 p refs Transl. into ENGLISH from Russian Report, 1967 p 163–202
(JPRS-44343) CFSTI: $3.00

An annotated bibliography is presented on Soviet studies pertaining to flight dynamics, structure and composition of the upper atmosphere, airglow, ionosphere, radio-wave propagation, magnetosphere, solar activity, cosmic rays, meteors and meterorites, lunar studies, planets of the solar system, and space biology and medicine. B.S.D.

N68-16338# Massachusetts Inst. of Tech., Cambridge. Geophysics Lab.
A MAGNETOTELLURIC INVESTIGATION OF AN ELECTRICAL CONDUCTIVITY ANOMALY IN THE SOUTHWESTERN UNITED STATES
Charles Moore Swift, Jr. (Ph.D. Thesis) Aug. 1967 226 p refs
(Contracts Nonr-1841(75); Nonr-(G)-00041-66)
(AD-663283)

Large scale magnetotelluric observations were made in the southwestern United States by combining telluric data from seven sites with Tucson geomagnetic observatory data. The use of the Tucson data as representative for the telluric recording sites is justified by a quantitative coherency study, which showed that the geomagnetic fluctuations of fifteen minute to diurnal periods in the southwest are characterized by horizontal wavelengths greater than 10,000 kilometers. The magnetotelluric data is analyzed for tensor apparent resistivities, principal directions, and two-dimensionality measures. The measured anisotropic apparent resistivities are interpreted in terms of inhomogeneous resistivity structure, using theoretical values obtained for two-dimensional models which took the known surface geology into account. The resulting interpretations show a high conductivity zone in the upper mantle of southern Arizona and southwestern New Mexico. Thus, the magnetotelluric evidence supports Schmuckers geomagnetic indication of increased conductivities. Partly because this region is characterized by high heat flow, these high conductivities are attributed to a zone of high temperatures. Author (TAB)

N68-16446*# Volt Technical Corp., Washington, D. C.
TO THE THEORY OF CONVECTIVE PHENOMENA IN GEOPHYSICS AND AERONOMY [K TEORII KONUEKTIVNYKH YAVLENIY V GEOFIYIKE I AERONOMII]
L. M. Alekseyeva and B. A. Tverskoy 26 Feb. 1968 5 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, Geofizika (USSR), v. 178, no. 3, 1968 p 588–590
(Contract NAS5-12487)
(NASA-CR-93068; ST-ES-AI-PF-10677) CFSTI: HC $3.00/MF $0.65 CSCL 04A

Two examples are given, one for the Earth's mantle and the earth's magnetosphere. The role of the ionosphere in these phenomena is considered and it is shown that the convective mixing does not affect the distribution of fast particles in the radiation belts. Author

N68-16450*# Hawaii Inst. of Geophysics, Honolulu.
A RE-EVALUATION OF THE THEORY FOR THE HYDROSTATIC FIGURE OF THE EARTH
Mohammad Asadullah Khan [1967] 32 p refs
(Grant NGR-12-001-045)
(NASA-CR-92996) CFSTI: HC $3.00/MF $0.65 CSCL 08E

The equations of the classical theory for the hydrostatic figure of the earth are modified in order to make their development independent of the external potential theory. These modifications are essential in order to study any discrepancy which may exist between the actual flattening f and the hydrostatic flattening f_h. An expression is obtained giving the hydrostatic flattening explicitly in terms of other parameters, which seems to have the advantage of easy numerical manipulation. The results obtained from the modified equations disagree with previous findings, giving a hydrostatic flattening of $1/296.70 \pm 0.05$ in contrast to the value of $1/299.86 \pm 0.05$. These results, if true, lead to the conclusion that the hydrostatic flattening of the earth is greater than its actual flattening, i.e., $f_h^{-1} - f^{-1} < 0$, in contradiction to the currently prevalent opinion that $f_h^{-1} - f^{-1} > 0$. Author

N68-16471# Tokyo Univ. (Japan). Inst. of Space and Aeronautical Science.
NUMERICAL STUDY ON FINITE AMPLITUDE HYDROMAGNETIC WAVES IN A MODEL MAGNETOSPHERE WITH THE DENSITY PLATEAU
Takashi Okuzawa Dec. 1967 21 p refs
(ISAS-417, V. 32, No. 10; Rept.-417)

Numerical experiments are performed on finite amplitude hydromagnetic (HM) waves to determine their gross behavior in a model magnetosphere including the density plateau. One dimensional HM equations are integrated with finite difference scheme in which physical dissipation is imitated by the Neumann–Richtmyer's artificial viscosity. The magneto-pause is assumed to be a piston boundary movable along radial direction on the equatorial plane. Normal incidence of the generated HM shock into the density plateau is followed with damped type oscillation of the piston boundary and with intensification of the strength of the shocks passing through the plateau. From the numerical solutions obtained, it is suggested that oscillatory motion of the magnetopause may be possible, on occasion, by the increase of the solar wind pressure even in a monotonical way, further, this feature may be helpful to suggest a possible means of the energy supply from the sunward to the cavity resonance system of the earth's magnetic field, and magnetic fluctuations after sc pulse may correspond to the successive gain of the influence of the piston. The heating efficiency behind the shock transition is high enough to raise ≈ 1 eV particles to those ≈ 100 eV of order in a maximum. Author

N68-16559# Weapons Research Establishment, Salisbury (Australia).
A YEAR'S MEASUREMENTS OF ATMOSPHERIC REFRACTION AT WOOMERA
M. S. Brown Sep. 1967 20 p refs
(WRE-TN-ISD-87) CFSTI: HC $3.00/MF $0.65

For a period of fifteen months at Woomera, an automatic camera fitted with a long focal length lens has been used to photograph two targets distant 100 ft and 8,000 ft. The films have been read to give information on diurnal and seasonal changes in atmospheric refraction angles on near-horizontal sightlines. Author

N68-16567*# Volt Technical Corp., Washington, D. C.
INVESTIGATION OF TYPE-Pi2 GEOMAGNETIC PULSATIONS AT MAGNETOCONJUGATE POINTS [ISSLEDOVANIYE GEOMAGNITNYKH PUL'SATSIY TIPA Pi2 V MAGNITPSOPRYAZHENNYKH TOCHKAKH]
O. M. Raspopov, V. A. Troitskaya, R. Shlish, I. S. Lizunkova, B. N. Kazak et al 23 Feb. 1968 6 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, Geofizika (Moscow), v. 178, no. 1, 1968 p 98–100
(Contract NAS5-12487)
(NASA-CR-93069; ST-GM-10675) CFSTI: HC $3.00/MF $0.65 CSCL 04A

Analysis of the behavior of Pi2-pulsations at Sogra and Kerguelen shows that it is similar at both conjugate points. This speaks in favor of the generation mechanism of Pi2-pulsations which explains it by the resonance of Alfven waves on the night side of the magnetosphere, in the tube of force directly adjacent to the beginning of the neutral layer. Author

N68-16571*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
ON THE GRAVITY GRADIENT AT SATELLITE ALTITUDES
W. Koehnlein 28 Jul. 1967 56 p refs
(Grant NsG-87)
(NASA-CR-93142; SAO Special Rept.-246) CFSTI: HC $3.00/MF $0.65 CSCL 04A

The horizontal and vertical components of the gravity gradient are computed along equipotential surfaces at altitudes of 0, 500, 1000, 5000, 10,000, 50,000, and 100,000 km, from Kozai's and Gaposchkin's harmonic coefficients. Accuracy estimates for the gravity gradients, as obtained from satellite orbits, are derived from a comparison with Kaula's CA solution. Author

N68-16627# Weapons Research Establishment, Salisbury (Australia)
ATMOSPHERIC ABSORPTION OF SOLAR RADIATION, WITH PARTICULAR REFERENCE TO TWILIGHT CONTAMINANT RELEASES
K. H. Lloyd Jun. 1967 29 p refs
(WRE-TN-HSA-123) CFSTI: HC $3.00/MF $0.65

Observations at Woomera of grenade glow clouds formed at twilight in the upper atmosphere have shown that there may be a large discrepancy between the observed earth's shadow height and its calculated value. On some occasions the shadow height appears to have been increased by tens of kilometers. The discrepancy is due to absorption and scattering of the sun's rays in the lower layers of the earth's atmosphere. The magnitude of this shadow height difference is calculated theoretically using results for the wavelength dependence of the atmospheric continuous absorption coefficient, which were obtained from ground-based observations on the intensity of the sun's rays at Woomera. Because of refraction effects, the increase in the earth's shadow height due to atmospheric absorption is much greater than the grazing height of the tangential rays. Author

N68-16698*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
A STUDY OF THE SEMIANNUAL DENSITY VARIATION IN THE UPPER ATMOSPHERE FROM 1958 TO 1966, BASED ON SATELLITE DRAG ANALYSIS

L. G. Jacchia, J. W. Slowey, and I. G. Campbell 15 Jan. 1968 29 p refs
(Grant NsG-87-60)
(NASA-CR-92668; SAO Special Rept.-265) CFSTI: HC $3.00/MF $0.65 CSCL 04A

The semiannual variation has been isolated on the drag data of six artificial satellites with perigee heights ranging from 250 to 658 km in the interval from 1958 through 1966 by suppression of all other known types of upper atmosphere variation with the help of empirical formulas. The temperature curves obtained from each of the six satellites are strictly in phase and show the same amplitude, irrespective of perigee height; peculiarities of the variation, such as an unusually broad minimum or a late maximum, are easily recognizable in each of the individual satellite curves. This shows that the semiannual variation is worldwide and that the observed density variations are the result of temperature variations at essentially the same atmospheric level as those arising from the solar-activity effect. All previously known features of the semiannual variation, such as the systematic inequality in the maxima and minima and the proportionality between the amplitude of the temperature variation and the 10.7-cm solar flux, are confirmed.
Author

N68-16733* Massachusetts Inst. of Tech., Cambridge. Dept. of Geology and Geophysics.
TERRESTRIAL VARIATIONAL TABLES FOR THE PERIODS AND ATTENUATION OF THE FREE OSCILLATIONS
Ralph A. Wiggins 1 Feb. 1968 87 p refs
(Grant NGR-22-009-123)
(NASA-CR-92717) CFSTI: $3.00 CSCL 08K

Perturbations of the Lagrangian integral for free oscillations of a radially heterogeneous self-gravitating sphere are used to compute tables relating the variation of periods and attenuation to the physical parameters. These tables are given for the fundamental and first and second overtones of the torsional and spheroidal free oscillations. Such tables can be used to determine earth models that are consistent with the observed periods of the free oscillations.
Author

N68-16778# Weapons Research Establishment, Salisbury (Australia).
FURTHER SPECTRAL OBSERVATIONS OF GRENADE GLOW CLOUDS IN THE LOWER THERMOSPHERE
E. R. Johnson and C. H. Low Mar. 1967 10 p refs
(WRE-TN-HSA-122) CFSTI: HC $3.00/MF $0.65

The spectral energy distribution is given for the glow clouds resulting from the explosion of aluminised grenades in the range of altitudes from 100 to 200 km. At night, over much of the spectral range from 300 nm to 800 nm, the spectrum is a continuum very similar to that of a black body at 4 000–5 000°K. At twilight emissions resulting from resonant scattering of sunlight by Al, K, Ba, Na and A10 are superimposed on, and dominate, the continuum.
Author

N68-16800# Weapons Research Establishment, Salisbury (Australia). Dept. of Supply.
IONOSPHERIC DATA FOR OCTOBER 1966 FROM WOOMERA, SOUTH AUSTRALIA
Jul. 1967 28 p
(CPD 1966/10/W/)

Tables of the hourly values of ionospheric parametric data for October, 1966, obtained from an ionosonde station at Woomera, South Australia, located at 30.8°S and 136.3°E, are presented. The characteristics of the radio recorder ionosonde are given.
L.S.

N68-16815# Environmental Science Services Administration, Boulder, Colo. Inst. for Earth Sciences.
AN ANALYSIS OF THE EARTH'S MAGNETIC FIELD FROM 1835 TO 1965
Keith L. McDonald and Robert H. Gunst Jul. 1967 91 p refs
(IER-46-IES-1) GPO: HC $0.50; CFSTI: MF $0.65

An analysis and description is given on the earth's magnetic field based on observed data from the time of Gauss to the most recent epochs. An attempt was made to collect all Gauss–Schmidt coefficients of previous investigators and extensive computations were made using selections of these data. Root-mean-square representations of geomagnetic field elements are employed to depict time trends and structural dissymmetries at the earth's surface and core-mantle boundary. Our analysis establishes that the magnetic dipole field is being driven destructively to smaller values by fluid motions which transform its magnetic energy into near neighboring modes rather than expend it more directly as joule heat. Sixth-degree analyses indicate that the mean magnetic-energy density in the outermost layers of the core fluid has been increasing. Defining an asymmetry ratio, our analysis infers by extrapolation that the geomagnetic field was sensibly symmetric in year 1670 A.D. The average rate of westward drift of the geomagnetic pole during the past 130 years is 0.042°/year in azimuth angle, corresponding to a polar rotation period of 8.6 thousand years.
Author

N68-16878# California Inst. of Tech., Pasadena. Seismological Lab.
RESEARCH IN SEISMIC PHENOMENA CONNECTED WITH EARTHQUAKES AND EXPLOSIONS Annual Report, 31 Oct. 1966–1 Nov. 1967
Don L. Anderson, Charles B. Archambeau, James N. Brune, and Stewart W. Smith Nov. 1967 32 p refs
(Contract AF 49(638)-1337; ARPA Order 292-63)
(AD-663219)

The report summarizes results in each of the categories below. These summaries serve to introduce the abstracts which follow. Structure of the Earth - body waves; Structure of the Earth - surface waves and free oscillations; Body wave and surface wave theoretical studies; Nonelastic properties of the Earth; Source studies; Instrumental development; Digital and analog recording.
Author (TAB)

N68-16899# Weapons Research Establishment, Salisbury (Australia). Dept. of Supply.
IONOSPHERIC DATA FOR NOVEMBER 1966 FROM WOOMERA, SOUTH AUSTRALIA
Jul. 1967 24 p
(CPD-1966/11/W/)

Tables are presented on the hourly values of the customary ionospheric parameters obtained from the Woomera, South Australia station.
Author

N68-17043*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SURVEY AND COMPARATIVE ANALYSIS OF CURRENT GEOPHYSICAL MODELS
Jesco von Puttkamer 28 Nov. 1967 70 p refs
(NASA-TM-X-53677) CFSTI: HC $3.00/MF $0.65 CSCL 08E

By using currently accepted constants of geodesy, notably several different sets of oblateness coefficients, seven models of the geometry of the earth and its gravitational field, including the currently valid NASA Standard Model, are numerically derived and compared with each other and with a newly developed geoid based on recent measurements of the secular and periodic perturbations of artificial satellite orbits.
Author

N68-17061# Wisconsin Univ., Madison. Dept. of Meteorology.
STUDIES IN ATMOSPHERIC ENERGETICS BASED ON AEROSPACE PROBINGS Annual Report, 1966
Verner E. Suomi Mar. 1967 134 p refs Prepared in cooperation with Santa Barbara Res. Center
(Grant CWB-WBG-27)
(PB-175997) CFSTI: HC $3.00/MF $0.65

Contents: ATS spin-scan cloud camera and prelaunch calibration procedure; the reflection of sunlight to space and the absorption by the earth and atmosphere over the United States during Spring, 1962; the albedo of a striated plane parallel turbid medium; the theoretical basis for low-resolution radiometer measurements from a satellite; the 'chirp' digital radiosonde; the prototype data logging system for the ESSA III flate-plate radiometers; the prototype flat plate radiometers for the ESSA III satellite. Author

N68-17063# Travelers Research Center, Inc., Hartford, Conn.
FURTHER DEVELOPMENT OF THE MODEL B COMPUTER CODE FOR ESTIMATING PARTICLE FALL AND DISPERSION IN THE ATMOSPHERE Final Report
K. D. Hage Aug. 1967 108 p refs Prepared for Sandia Corp.
(SC-CR-67-2645) CFSTI: HC $3.00/MF $0.65

A computer code developed previously as a tool for investigating possible hazards associated with aborted missions and orbital-decay reentries of space vehicles using nuclear fuels is modified and refined for increased accuracy and usefulness. Model calculations of the transport and dispersion of monodisperse particles suggest that reasonable estimates of concentrations and densities can be obtained from a Gaussian mass distribution fucntion for particles of 20 microns dia and larger. The two-dimensional sub-division procedures contained in Model B appear to be superior to both one-dimension and three-dimensional subdivision for calculating the dispersion of monodisperse particles. Author (NSA)

N68-17132# McGill Univ., Montreal (Quebec). Stormy Weather Group.
MEASUREMENT OF SNOWFALL BY OPTICAL ATTENUATION
Charles Warner and K. L. S. Gunn Nov. 1967 36 p refs
(MW-51)

A transmissometer has been used to provide a continuous record with good time resolution of falling snow. The pulsed light, of wavelength 0.45μ traversed a path 71 m long about 20 m above ground level. A total snow amount of 175 millimeters of water was recorded from 18 storms through the 1966-67 winter season. Attenuation by snow was found to be proportional to rate of snowfall, with the constant of proportionality 11 (db km^{-1})/(mmw hr^{-1}). A previous experiment by Lillesaeter yielded 18 for this constant. The attenuation from precipitation-free air was found to increase as the relative humidity increased above about 60%. Relative humidity increase between the beginning and end of a storm could lead to an increase in "clear air" attenuation of 4-5 db km^{-1} Lack of correction for this along with the effect of thermal fluctuations on Lillesaeter's narrower transmitted beam probably account for his higher value of the constant of proportionality. Snow amounts per storm deduced from attenuation records agreed with amounts measured by standard instruments to within a factor 2. When depths on the ground were compared, agreement was within a factor 1.5. Author

N68-17139*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A MODEL OF THE MAGNETOSPHERIC TEMPERATURE DISTRIBUTION
H. G. Mayr and H. E. Volland Nov. 1967 23 p refs
(NASA-TM-X-63098; X-621-67-569) CFSTI: HC $3.00/MF $0.65 CSCL 04A

As IMP-2 measurements of the low energy electron spectra in the magnetosphere showed that these electrons have an almost Maxwellian velocity, a rigorous treatment of heat conduction was undertaken. It was found that heat conductivity is effectively decreased in regions of low electron densities, causing a general increase of temperature at greater height. The effect of turbulent heat transfer perpendicular to the magnetic field lines is estimated in order to understand the ion-electron temperature differences observed in the upper magnetosphere. Equations are derived to show that under magnetospheric conditions of low density, the heat conductivity becomes dependent on density and almost independent of temperature. A model of magnetospheric temperature distribution was constructed, with three regions defined: (1) the lower magnetosphere, where the temperature distribution is determined by a normally high heat conduction due to high plasma densities associated with heat received from the ionosphere; (2) the middle magnetosphere, where parallel heat conductivity can be largely decreased by low plasma densities; and (3) the upper magnetosphere, where perpendicular heat transfer becomes significant. M.G.J.

N68-17182*# IIT Research Inst., Chicago, Ill.
NIGHTGLOW OBSERVATIONS DURING NASA'S MOBILE LAUNCH EXPEDITION NUMBER 1 Final Report
J. A. Greenspan Dec. 1967 33 p refs
(Contract NASr-65(11))
(NASA-CR-93157) CFSTI: HC $3.00/MF $0.65 CSCL 04A

Continuum compensated observations of the atmospheric emissions $[01]_{21}$ λ6300 Å, $[01]_{32}$ λ5577 Å, and N_2^+ (0-1) λ4278 Å were made at the zenith and at elevation angles of 75° and 85°. In addition, observations of the continuum near 6200 Å, 5477 Å, and 4178 Å were made at the zenith. Data was obtained on 63 nights representing the totality of nights at sea less one. The observing period extended from sunset to sunrise. The instrumentation is described and the observing procedure outlined. The data obtained are summarized and sample records are presented. Diurnal variations and latitude effects in the 5577 Å and 6300 Å zenith intensities have been examined and the results, which have been published, are discussed. First attempts at correlating the red line intensity with h'F and f_0F_2 through Barbier's formula have been made and the results are presented. The phenomenology of the red line emission is discussed in terms of the results of these measurements. Author

N68-17200*# Midwest Research Inst., Kansas City, Mo. Mathematics Analysis Section.
STUDY OF ATMOSPHERIC AND AAP OBJECTIVES OF CROSS BEAM EXPERIMENTS Final Report, 23 Jan. 1967-9 Jan. 1968
A. D. St. John and W. D. Glauz 26 Jan. 1968 207 p refs
(Contract NAS8-21065)
(NASA-CR-61191) CFSTI: HC $3.00/MF $0.65 CSCL 04A

Described is a remote sensing technique that uses the triangulation of two collimated light beams to study fluid flow phenomena in the regions near the point of beam intersection or near the line of minimum separation between nearly intersecting beams. The fluctuations of radiative power received at the two detectors are multiplied and averaged and the resulting two-beam value is then used to determine the optical properties of fluid flow fluctuations. Operational application of this method to the flow of electromagnetic energy through the atmosphere shows that a cloud will block access to information, and that the two-beam technique does not work in successive regions of variable lighted or variably emissive backgrounds such as a cloud surface to the earth's surface. Rankings of potential applications for ground based, aircraft based, and orbit based systems are included. G.G.

N68-17201# France. Ministere de l'Air, Paris.
CONTRIBUTION TO THE STUDY OF INTERCEPTOR DRAINS IN POROUS MEDIUMS [CONTRIBUTION A L'ETUDE DES DRAINS D'INTERCEPTION EN MILIEU POREUX]
Amitabha das Gupta 1967 112 p refs In FRENCH
(Rept.-438)

Influence on the behavior of underground water-level with a free surface is considered for a drainpipe which intercepts part of the outflow. The principal research method employed was that of viscous analogy, which resulted in a new validity criterion. Tracing the free surfaces, measuring outflow next to the pipes, and

the current lines are described in relation to porous media. A comparison of these results is made by electric analogy, and the particular case of a drain placed between horizontal partitions is considered. Transl. by M.W.R.

N68-17211*# Volt Technical Corp., Washington, D. C.
ON THE BEHAVIOR OF TYPE-PI1 MICROPULSATIONS AT MAGNETOCONJUGATE POINTS [O POVEDENII MIKROPUL' SATSIY TIPA PIL V MAGNITOSOPRYAYHENNYKH TOCHKAKH]
O. M. Raspopov, V. A. Troitskaya, P. Gandrin, B. W. Kazak, and J. Loran 23 Feb. 1968 6 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, Geofizika (USSR), v. 178, no. 2, 1968 p 345–347
(Contract NAS5-12487)
(NASA-CR-93070; ST-GM-AA-10676) CFSTI: HC $3.00/MF $0.65 CSCL 04A

The Sip-bursts, one of the forms of Pi1-micropulsations, are studied at Sogra and Kerguelen. The Nishida theory on the mechanism of their onset finds its corroboration in the case of the concomitant shift of the aurora zone. However, the authors disagree with the latter, when it ascribes Pi2-pulsations to the same mechanism, except for oscillations with period < 5–10 sec. Author

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N68-16117*# Aerojet-General Corp., El Monte, Calif. Space Div.
MICROWAVE RADIOMETER DESIGN AND DEVELOPMENT, VOLUME 1 Final Report
15 Nov. 1967 82 p
(Contract NAS5-9680)
(NASA-CR-92670) CFSTI: HC $3.00/MF $0.65 CSCL 20F

A description of the project, system, subsystem, and components of the microwave radiometer is presented. The theory and functional operation of the system is given, along with photographs and engineering drawings of various components. Details are also given on the radiometer test set which provides interface signals necessary to simulate the Nimbus spacecraft from the antenna port to the various telemetry outputs. The meteorological radiometer data acquisition and display system is discussed. This system commands, times, and records the operation of the meteorological radiometer while providing a time history gray scale representation of the scanned radiometer output values. The procedures for the bench test calibration of the radiometer and the field test calibration of the antenna are reported. B.S.D.

N68-16123# Los Alamos Scientific Lab., N. Mex.
A 90° ^{3}He NEUTRON SPECTROMETER
W. K. Brown, A. N. Ellis, and D. D. Peterson 2 Nov. 1967 24 p refs
(Contract W-7405-ENG-36)
(LA-3752) CFSTI: HC $3.00/MF $0.65

A fast ^{3}He neutron spectrometer has been developed that is free of recoil spectrum effects. Positioning solid-state detectors outside the neutron beam at 90° yeilds this advantage and precludes nuclear reactions in the detectors themselves. Operating in conjunction with a pulse-height analyzer, the spectrometer covers the energy range $0.1 < E_n < 6$ MeV, or higher, with an energy resolution of $\approx \pm 10\%$. In a time-of-flight, current signal operating mode, the energy range is extended to very low neutron energies. The spectrometer was used in the latter manner to measure the neutron spectrum of the Persimmon experiment conducted at the Nevada Test Site in February 1967. Author (NSA)

N68-16131# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
SOURCE OF REFERENCE SIGNALS FOR SPECTROMETRIC SCINTILLATION COUNTERS BASED ON ELECTROLUMINESCENT DIODES [ISOTOCHNIK REPERNYKH SIGNALOV DYLA SPEKTROMETRICHESKIKH STSINTILLYATSIONNYKH SCHETCHIKOV NA OSNOVE ELEKTROLYMINESTENTNYKH DIODOV]
M. N. Omelynenko, V. K. Tyupikov, and V. V. Filchenkov 1967 9 p refs In RUSSIAN
(JINR-P13-3523)

An oscillator reference signals for scintillation spectrometers based on the SiC and GaP electroluminescent diodes is described. The pulse width being 0.5–1 μs and the rise time 0.1–0.2 μs. The womp brightness is regulated in the range corresponding to the scintillation amplitudes while recording the 1–15 MeV neutrons. The temperature instability is compensated and can be less than 0.2%°C. Author (NSA)

N68-16138# Union Carbide Corp., Oak Ridge, Tenn. Nuclear Div.
GRAVIMETRIC STANDARD FOR PRIMARY GAS FLOW MEASUREMENTS
W. T. Collins 18 Oct. 1967 13 p Presented at the 88th Ann. Meeting of the Am. Soc. of Mech. Engr., Pittsburgh, 12–17 Nov. 1967
(Contract W-7405-ENG-26)
(K-L-6181; CONF-671101-4) CFSTI: HC $3.00/MF $0.65

A gravimetric standard consisting of a balance, weighting bottles, bottle valve, sealing device, control orifice, and diverting valves is used for primary gas flow measurement. The calibration and precision of the standard are given. NSA

N68-16147# Institut Franco-Allemand de Recherches, St. Louis (France).
DETERMINATION OF THE POSSIBILITIES OF CINEHOLOGRAPHY, ESPECIALLY FOR THE STUDY OF MOVING OBJECTS [DETERMINATION DES POSSIBILITIES DE LA CINEHOLOGRAPHIE, NOTAMMENT EN VUE DE SON APPLICATION A L'ETUDE DES OBJECTS EN MOUVEMENT]
P. Smigielski and H. Royer 9 Mar. 1967 33 p refs In FRENCH
(Contract DRME-185/66)
(ISL-1/67)

Photographic emulsion, geometric irregularities, oscillations, coherence, and illumination factors are evaluated for the reconstruction of good quality pictures. Also determined is the effect of movement on the reconstruction quality. Described is the combined method of cineholography and interferometry with double exposure and its application in analyses of wave surfaces in wind tunnels, free flight test facilities, and shock tubes. Holograms of three dimensional objects at equilibrium and in motion, of gas flow, cineholograms, and holograms for nano second motion are included. Author

N68-16153# Institut Franco-Allemand de Recherches, St. Louis (France).
SIMULTANEOUS UTILIZATION OF IMAGES TRANSMITTED AND REFLECTED BY A FOUCAULT DEVISOR [UTILISATION SIMULTANEE DES IMAGES TRANSMISE ET REFLECHIE PAR UN COTEAU DE FOUCAULT]
H. Royer 23 Nov. 1966 12 p refs In FRENCH
(ISL-T-30/66)

Combined application of schlieren and reflection image pictures increases the sensitivity and brightness factors in differential analyses. Substitution of schlieren lenses by interference gratings improves those properties even more. Author

N68-16162*# Neotec Corp., Rockville, Md.
ISOTHERMAL HEAT FLUX SENSING UNIT Final Report, Jun. 21, 1967–Jan. 2, 1968
Donald R. Webster and Ronald C. Cannizzaro 2 Jan. 1968 91 p refs
(Contract NAS8-21069)
(NASA-CR-61510; CR-26.1) CFSTI: HC $3.00/MF $0.65 CSCL 20M

Details are given on the thermal analysis, theory of operation, and operating instructions of the isothermal heat flux sensing unit (IHFSU). The instrument is capable of evaluating the characteristics of multiple thermal coatings in the actual environment within which these coatings are intended to operate. A detailed thermal analysis was performed to determine the minimum weight and power requirements consistent with a useful experiment. The results showed that the IHFSU has the capability of meeting the 250°K lower sample temperature with an acceptable power requirement of 35 to 40 watts. The operation theory pertaining to the three electronic packages—heat sink and thermoelectric units, sensors electronics package, and the external sequencer—is discussed. The operating instructions are delineated and the methods of connecting and operating these three units are described. The source listing of the subroutine and input deck listing for the thermal analyzer computer program are given. B.S.D.

N68-16166# Institut Franco-Allemand de Recherches, St. Louis (France).
LIGHT MEASURING APPARATUS FOR ROCKET ASCENTS [LICHTMESSGERAET FUER RAKETENAUFSTIEGE]
D. Bock and F. Roessler 15 Dec. 1966 37 p refs In GERMAN
(Contract T-656-I-206)
(ISL-11/66)

A detailed description is given for the mechanical construction and electric circuitry of a modified apparatus to measure atmospheric light diffusion up to 100 km height. The device used light modulation methods and is included into the tip of a sounding rocket. Also discussed are calibrating methods and experimental measurements with the device. Author

N68-16186# Deutsche Forschungsanstalt fur Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Strahlantriebe.
THE CHANGE OF SENSITIVITY OF TURBINE-FLOW METERS BY MEANS OF CONTAMINATION OF THE FLOWING MEDIUM [AENDERUNG DER EMPFINDLICHKEIT VON TURBINEN-DURCHFLUSSMESSERN DURCH ABLAGERUNGEN AUS DEM ARBEITSMEDIUM]
Paul Nitsch and Wolfgang Wehling May 1967 23 p refs In GERMAN; ENGLISH summary
(DLR-Mitt.-67-19)

The sensitivity of turbine-flow-meters may be changed by deposits of contaminations of substances solved in the flowing medium. After long working-time the shift of the characteristic may far exceed the margin of error given by the producer. The error of sensitivity influences the precision of mass flow measurements. Therefore the results of this measurement may lead to false conclusion if the characteristic is assumed to have no shift during running time. It is pointed out, that the change of the sensitivity of turbine-flow-meters after a working-time of 300 hours in normal water can amount to fourteen times the repeatibility given by the producer. A device for measuring the sensitivity of flow-meters with a mean error of 0.1% is described. Author

N68-16208# Instituto Geografico y Castastral, Madrid (Spain).
A SOLUTION FOR THE MEASURE OF THE ELEMENTS H AND Z WITH ATOMIC MAGNETOMETER AND HELMHOLTZ BOBBINS [UNA SOLUCION PARA LA MEDIDA DE LOS ELEMENTOS H Y Z CON MAGNETOMETRO ATOMICO Y BOBINAS DE HELMAHOLTZ]
Angel Garcia Cogollor 1966 23 p In SPANISH

The use of atomic magnetometers and Helmholtz coils in measuring the elements H and Z (the geomagnetic field F is the vectoral sum of the elements H and Z), the construction of the bobbin, and the method of observation are described in detail. In addition to its low cost, the atomic magnetometer has the advantages of yielding an absolute value of a universal character, its method of observation and calculation are extremely easy and fast, and the value of F can be obtained within a few seconds. Its approximation is superior to that of any preceeding apparatus and it can obtain the gamma without difficulty. Transl. by R.N.A.

N68-16251# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Institut fuer Flugfuehrung.
COMPARATIVE VIBRATION TESTS WITH ELECTROLYTIC LEVELS AND MERCURY SWITCHES [VERGLEICHENDE VIBRATIONSUNTERSUCHUNGEN AN ELEKTROLYT-IBELLEN UND QUECKSILBERSCHALTERN]
Volker Wetzig 15 Oct. 1967 42 p refs In GERMAN; ENGLISH summary
(DLR-FB-67-76; DK-62-752; DK-532.291; DK-621.546.3)

The report deals with tests measuring the influence of linear and circular translational case vibrations on the indication accuracy of electrolytic level and mercury switch gravity sensors. Characteristic differences in the vibration sensitivity of the electrolytic levels for circular vibrations is theoretically explained. An electrolytic test level, substantially less sensible to circular vibrations, is described. Author

N68-16263*# ITT Industrial Labs., Fort Wayne, Ind.
CONTINUOUS SCANNING METEOROLOGICAL CAMERA SYSTEM FOR ATS Final Report, 22 Sep. 1965–10 Sep. 1967
10 Nov. 1967 16 p
(Contract NAS5-9671)
(NASA-CR-92709; ITTIL-67-1054) CFSTI: HC $3.00/MF $0.65 CSCL 14E

This report presents a chronological review of activities in the development of the image dissector camera system for the Applications Technology Satellite. Areas of performance are traced from initial design studies through qualification testing of the prototype camera. Author

N68-16310# National Center for Atmospheric Research, Boulder, Colo.
A TAPE PROGRAMMED SEQUENTIAL SAMPLER
A. David Gibson 1967 4 p
(Contract NSF C-460)
(PB-175925) CFSTI: HC $3.00/MF $0.65

A description is given of an atmospheric particle sampler which is designed to achieve greater reliability than those currently available through the use of a sequencing mechanism employing a perforated plastic tape and a synchronous motor timer. Author

N68-16320*# Varian Associates, Palo Alto, Calif.
ATOMIC TIME AND FREQUENCY REFERENCE SYSTEM, PART 1 Final Report, 13 Jan. 1966–15 Nov. 1967
15 Nov. 1967 72 p
(Contract NAS9-5425)
(NASA-CR-65942) CFSTI: HC $3.00/MF $0.65 CSCL 14B

In further development of a rubidium atomic time and frequency reference system for manned spacecraft use, details are presented on the breadboard frequency standard and flyby space clock. Consideration is given to the optical package, analog circuits, digital circuits, and power supply in describing the complexities of the electrical equipment for the clock. The test and calibration unit for checking the frequency standard prior to flight is discussed in relation to three major circuit areas; the monitor and control circuits, digital clock setting circuits, and power module. The problems of thermal and mechanical design for long term unattended operation are considered, and the way they manifest themselves in the

various parts of the space clock is discussed. Design changes for improvements in the performance of the breadboard are defined. B.S.D.

N68-16341# European Space Technology Center, Noordwijk (Netherlands).
THE DISC FLUXMETER DEVELOPED AT ESTEC
M. Janes Paris ESRO Sep. 1967 27 p
(ESRO-TM-7) CFSTI: HC $3.00/MF $0.65

The disk fluxmeter described provides a means of measuring the radiant energy over a solid angle of 2π and can be used as a standard. It consists of a thin copper disk as sensor, which is painted black on both surfaces and is surrounded by a guard-ring. The sensor is fixed to a support which is kept at constant temperature. The change in temperature of the sensor is a measure of the incident radiation. The basic equation used to calculate the incident flux from the readings of the fluxmeter is derived. The experiment carried out to test the fluxmeter in a heat balance facility is described, and the results are tabulated. A discussion of these results follows, with an estimate of the experimental errors. Author (ESRO)

N68-16373# European Space Research Organization, Paris (France).
CALIBRATION FACILITIES OF LIGHT SOURCES AND RELATED PROBLEMS
F. Di Benedetto Aug. 1967 18 p ref
(ESRO-SN-44) CFSTI: HC $3.00/MF $0.65

It was agreed to seek information, within the member states of ESRO, on the calibration facilities of light sources used in astronomy. A questionnaire was accordingly sent to the physicists and astronomers concerned. A summary of the replies is presented; they came from Royal Obs. Edinburgh, Space Res. Lab. Utrecht, Landesstemwarte Heidelberg, Astrophysics Inst. Liége, MPI for Extraterrestrial Physics, Munich and Culham Lab. Author (ESRO)

N68-16377# Air Force Cambridge Research Labs., Bedford, Mass. Upper Atmosphere Physics Lab.
POSITIVE ION-SENSING SYSTEM FOR THE MEASUREMENT OF SPACECRAFT ATTITUDE
Rita C. Sagalyn and Michael Smiddy *In* Office of Aerospace Res. Proc. of the OAR Res. Appl. Conf., 14 Mar. 1967 Mar. 1967 p 1–18 refs (See N68-16376 07-34)

An attitude sensing system using the properties of ambient, positive ions was successfully flown on Gemini spacecraft 10 and 12. The outputs of two planar electrostatic analyzers mounted symmetrically about the appropriate axis are combined to give pitch and yaw angles directly. The system could be readily adapted for manned or unmanned rockets, satellites or supersonic aircraft. In-flight and post-flight comparison with the inertial guidance system on Gemini spacecraft shows that the ion system functions extremely well. Significant reductions in required power, weight, warm-up time, cost, and greatly improved response time make this a potentially valuable technique for future space navigation. Author

N68-16391# Technische Hochschule Hannover (West Germany). Arbeitsgruppe fuer Bautechnischen Strahlenschutz.
THE DIRECTIONAL DEPENDENCE OF THE MEASURED VALUES FROM SOME GAMMA DOSIMETERS [DIE RICHTUNGSABHAENGIGKEIT DER MESSWERTANZEIGE EINIGER GAMMADOSIMETER]
K. Heinze Dec. 1966 13 p In GERMAN
(ABS-THH-1037)

In order to obtain concepts on how the orientation of a measurement device or detector in a radiation field can be effected, the directional dependence of the data was investigated for energy and direction distribution of a γ source. A ^{60}Co source with a mean energy of 1.25 MeV was used. The detectors were so arranged that they were intersected by almost parallel beam bundles (monodirectional direction distribution). The measurement results were graphed for several devices. NSA

N68-16392# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
FORMATION AND LINEAR AMPLIFICATION OF SIGNALS IN NUCLEAR SPECTROSCOPY [FORMATION ET AMPLIFICATION LINEAIRE DES SIGNAUX EN SPECTROSCOPIE NUCLEAIRE]
Rene Le Du and Jean-Daniel Meites Sep. 1967 15 p In FRENCH
(CEA-R-3252)

The apparatus described can be associated to various detectors used in nuclear physics, either rapid, its rise time always under 30 nanoseconds, or slow, because of its continuous connections. Its gain can be increased very progressively from 2000 to 10 by increasing the feedback factors. The maximum permissible entry voltage, without causing any increase in the dead-time, is 12 volts, whatever the value of the gain. The device is fitted with two continuous exits giving signals of equal amplitude but of opposite sign (10 volt pulses followed by a 4 volt undershoot). Its controls, all accessible, make it possible to adapt the apparatus very rapidly to various measurements. It is completely transistorized and the amplifier is fitted into a Renatran 2/8 drawer. A gain 4 preamplifier in the same drawer makes it possible to obtain a total gain of 8000. Author (NSA)

N68-16399# Royal Aircraft Establishment, Farnborough (England).
ELECTRICALLY OPERATED CHRONOMETER ESCAPEMENTS. NEW TRANSISTOR APPLICATIONS [ENTRETIEN ELECTRIQUE DES BALANCIERS DE CHRONOMETRIE. NOUVELLES APPLICATIONS DES TRANSISTRONS]
M. Lavet Aug. 1967 29 p refs Transl. into ENGLISH from Rev. Gen. de l'Elec. (Paris), v. 68, no. 3, 1959 p 191–221
(RAE-LIB-TRANS-1248)

The Author, after referring to the fundamental inventions in electrical watch-making, inventions which have prepared the way for the production of modern electric watches, reviews the characteristics of impulse drives as applied to watches at present in use, pointing out the drawbacks of moving contacts for which semiconductor crystal amplifiers are in any case being substituted. The article is concluded with a study of the new possibilities introduced by the use of transistors in this field, in particular the operation (without material connections) of free balance wheels by means of devices which have made it possible to produce a low-frequency standard (1–10 cps) of relatively simple design. Author

N68-16409# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.
AUTOMATIC DEVICE FOR COMPENSATING THE EARTHS MAGNETIC FIELD AROUND A β SPECTROMETER [ENSEMBLE AUTOMATIQUE DE COMPENSATION DU CHAMP TERRESTRE AUTOUR D'UN SPECTROMETRE β]
Christian Ristori (Ph.D. Thesis) Aug. 1967 74 p refs In FRENCH
(CEA-R-3247)

It is shown how the earth's magnetic field inside a double focusing, $\pi\sqrt{2}$, iron-free, beta spectrometer (radius 50 cm) was compensated. Three orthogonal magnetic fields are generated by three sets of square coils. Each stabilized power supply is regulated through its own magnetometer (of the fluxgate type) and the earth field inside the spectrometer is compensated to 10^{-4}Oe whatever the earth field or power supply oscillation could be. Author (NSA)

N68-16466# Weapons Research Establishment, Salisbury (Australia).
A HIGH SENSITIVITY SCANNING SPECTROMETER FOR FIELD USE

P. R. Gillingham Oct. 1966 56 p refs
(WRE-TN-PAD-120) CFSTI: HC $3.00/MF $0.65

The design of a spectrometer with a scanning rate from one to five per second, for the measurement of faint sources against the night sky, is studied on a general basis, including a comparison of photomultipliers and photographic emulsions, and of dispersive and interferometric spectral analysers. An instrument using a wedged interference filter with a photomultiplier is shown to have important advantages, particularly with extended sources. The detailed design and the measured performance of such an instrument are discussed. Author

N68-16492# Navy Electronics Lab., San Diego, Calif.
VIBRATION ANALYSIS BY HOLOGRAPHIC AND CONVENTIONAL INTERFEROMETRY Research and Development Report, Mar.–Apr. 1967
M. A. Monahan and K. Bromley 8 Sep. 1967 44 p refs
(NELC-1513; AD-663271)

Describes two relatively new and useful optical techniques for measuring deformation of surfaces. Verifies results of holographic vibration analysis by comparison of results obtained with modified Twyman-Green interferometer. The hologram has the advantage of providing contour map of vibration amplitude of entire surface for particular frequency and drive, whereas more conventional techniques can be used to investigate only one point on surface at a time. Neither method requires attachment of sensors to surface being measured, and both may be applied to surfaces submerged in transparent liquids. Author (TAB)

N68-16506*# Parametrics, Inc., Waltham, Mass.
ULTRASONIC TEMPERATURE MEASURING DEVICE Final Report
L. C. Lynnworth and E. H. Carnevale Aug. 1967 143 p refs
(Contract NAS3-7981)
(NASA-CR-72339) CFSTI: HC $3.00/MF $0.65 CSCL 14B

A pulse-echo ultrasonic system was designed, constructed and tested for automatically determining temperature by measuring the round trip transit time in a wire sensor. Laboratory tests were conducted to the melting point of Re in carbon-free vacuum, and up to the Re/C eutectic in a graphite environment. Rhenium wires irradiated to 8.7×10^{19} integrated thermal flux and 2.6×10^{19} integrated fast flux showed no significant differences in the velocity/temperature characteristic. In the field tests in a graphite/hydrogen environment, bare Re sensors survived to temperatures ranging up to 4765°R. Author

N68-16529*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AN UNCERTAINTY ANALYSIS FOR SATELLITE CALORIMETRIC MEASUREMENTS
John P. Millard Washington Feb. 1968 64 p refs
(NASA-TN-D-4354) CFSTI: HC $3.00/MF $0.65 CSCL 20M

The use of an uncertainty analysis for analyzing current data and for designing future satellite calorimetric experiments is described. Calorimetric experiments considered are those for measuring the radiative properties of solar absorptance and infrared emittance of test surfaces, and those for measuring the emissive and reflective properties of the sun and planets. The paper describes the uncertainty-analysis technique, lists all pertinent equations for each measurement, presents several illustrative examples, and includes a section on design guides for future experiments. Author

N68-16542# Rochester Univ., N. Y. Dept. of Physics and Astronomy.
SIMULATION OF IMAGE-PLANE-DIGITIZER MEASUREMENTS
H. Yuta, T. Ferbel, and J. C. Berlinghieri 24 Oct. 1967 11 p refs
(Contract AT(30-1)-875)
(UR-875-219) CFSTI: HC $3.00/MF $0.65

Image-Plane Digitizers (IPD) are used for measuring high-energy bubble chamber interactions. IPD data are simulated to determine whether IPD's can be used successfully at energies above 7 GeV/c and particularly at 13 GeV/c. The methods of simulation, results, and conclusions are presented. NSA

N68-16543# Princeton Univ., N. J. Palmer Physical Lab.
AUTOMATIC PATTERN RECOGNITION AND EVENT MEASUREMENT ON BUBBLE CHAMBER PHOTOGRAPHS WITH A MODIFIED PEPR-TYPE MACHINE
M. E. Sekely 26 Jul. 1967 42 p
(Contract AT(30-1)-2137)
(PPAD-628E) CFSTI: HC $3.00/MF $0.65

An attempt was made to balance and minimize the measurement precision requirements in coordinates and angles for a PEPR type machine for the purposes of practical pattern recognition and adequately accurate track parameter computations. The systems analysis showed the superiority of the tangent mechod over the point processing methods both for accuracy (by using analytical error estimates, thus avoiding the pitfalls of computer-simulation procedures) and for the volume of necessary computations and gave closed-loop algorithms for pattern recognition and a very fast spatial reconstruction scheme which bypasses the Thresh routine and furnishes complete track parameters and errors usable for an on-line kinematic check of the recognized patterns. It promises to achieve the sole purpose of our effort—faster and cheaper data processing. To compute angles and momenta to the required maximum 10 bit precision, data measured with 12 bit precision are adequate if one uses the given algorithms and a new method to correct for optical distortion. The calculations can be executed in fixed point single precision mode with the PDP-7 used for scanning and pattern recognition. Author (NSA)

N68-16544# Maryland Univ., College Park. Dept. of Physics and Astronomy.
A VIDICON SYSTEM FOR BUBBLE COUNTING AND TRACK MEASURING
Donald Keith Day 1967 38 p refs Sponsored by AEC
(ORO-2504-110; TR-730) CFSTI: HC $3.00/MF $0.65

A video picture of a 1 cm by 0.44 cm section of a bubble chamber photograph projected on a scanning table is digitized and recorded on magnetic tape as 9216 bits, along with data from an up-down scaler which gives the coordinates of the picture taken as 36 bits. Also available are 36 binary bits for recording auxiliary information. The digitized information may then be reduced by a high-speed computer to provide useful data such as precise track coordinates and bubble densities or gap length distributions. The track coordinates are used in the analysis of bubble chamber events. The gap length distribution can be used to distinguish between particles of different mass whose tracks have about equal curvatures in the magnetic field of the bubble chamber. Author (NSA)

N68-16550# Lyon Univ. (France).
TIME RESOLUTION OF LITHIUM COMPENSATED GERMANIUM DETECTORS [RESOLUTION ENTEMPS DES DETECTEURS AU GERMANIUM COMPENSE AU LITHIUM]
Jean-Clause Balland (Ph.D. Thesis) Sep. 1967 111 p refs In FRENCH
(LYCEN-6766)

At attempt is made to develop a simplified formulation of the problem of time measurements using Ge(Li) detectors by taking into consideration the physical characteristics of these detectors and the limitations due to the associated electronic instrumentation. The properties of these detectors and the physical processes for gamma detection are reviewed. The electronic problems connected

with energy resolution are then analyzed. Time measurements are studied theoretically. The instrumentation used is described. The amplification and discriminator circuits are given. Experimental results obtained in time resolution are shown graphically. NSA

N68-16563# Commissariat a l'Energie Atomique, Saclay (France). Dept. de Physique du Plasma et de la Fusion Controlee.

INTRODUCTION TO HOLOGRAPHY: THEORY AND EXPERIMENTAL EQUIPMENT [INTRODUCTION A L'HOLOGRAPHIE: THEORIE ET DISPOSITIFS EXPERIMENTAUX]

Terenzio Consoli, Georges Proca, and Lucien Slama Sep. 1967 99 p refs In FRENCH; ENGLISH summary

(CEA-R-3256) CFSTI: HC $3.00/MF $0.65

This work presents the theory and the techniques in the field of holography. It makes a synthesis of the present knowledge in that field. Author (ESRO)

N68-16582*# Minnesota Univ., Minneapolis. School of Physics and Astronomy.

A FOCUSING X-RAY TELESCOPE FOR HIGH ALTITUDE OBSERVATIONS OF COSMIC X-RAYS IN THE ENERGY RANGE 20–140 KEV

Thomas Russel Lindquist (M.S. Thesis) Dec. 1967 87 p refs

(Grant NsG-281)

(NASA-CR-92951; CR-110) CFSTI: HC $3.00/MF $0.65 CSCL 03A

Details are given on the design and construction of an X-ray telescope for focusing hard X-rays from a large collection area to a small focal area. Its lens consists of approximately 4000 rock salt crystals, chosen primarily for their relatively high reflecting power; measurement data on the reflectivity are given. Pertinent aspects of X-ray diffraction theory are discussed. Two possible versions of the focusing X-ray telescope are compared with other X-ray detectors, and it is shown that the focusing telescope has the narrowest field of view, and greater sensitivity at 30 KeV although this advantage diminishes rapidly with increasing energy. It is pointed out that the telescope's good sensitivity, especially in the 20 to 40 KeV energy range where the flux detected at balloon altitudes is greatest, makes it well suited for collecting data on weak sources in short times or discovering new sources provided that it can be kept pointed accurately at the region of interest. M.G.J.

N68-16672# Atomic Power Development Associates, Inc., Detroit, Mich.

DEVELOPMENT OF THE UNDER-SODIUM ULTRASONIC SCANNER

C. C. Scott and Shuh-pan Ying Oct. 1967 86 p refs

(Contract AT(11-1)-865)

(APDA-210) CFSTI: HC $3.00/MF $0.65

A scanning system that employs a focusing transducer for producing a single narrow ultrasonic beam for locating and discerning objects in high-temperature opaque media, such as 600 F liquid sodium, has been developed. The feasibility studies that preceded development of the system and the developmental work involving acoustic parameters, design and analysis of the mechanism, experimental results, and practical demonstrations are discussed. The focusing transducers were operated at frequencies of 2.25 and 5 Mc/sec with lead zirconate-titanate piezoelectric ceramic disks at distances from 1/4 inch to approximately 3 feet from the targets. The zirconium planospherical lenses of the focusing transducers not only provided single focusing points but also, suppressed side lobes radiated from the transducers at distances far beyond the focal points. The direction and the range of a target were read from the orientation of the transducer and the cathode ray oscilloscope, respectively. For display of images of targets, a current-sensitive helix wire recorder was used. The scanner resolution for both distance and orientation was found satisfactory. Author (NSA)

N68-16679# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE USE OF $D(d,n)He^3$ AND $T(d,n)He^4$ NUCLEAR REACTIONS TO CALIBRATE FAST NEUTRON RADIOMETERS [K VOPROSU OB ISPOL'ZOVANNI YADERNYKH REAKTSIY $D(d,n)He^3$ I $T(d,n)He^4$ DLYA GRADUIROVKI RADIOMETROV BYSTRYKH NEYTRONOV]

R. D. Vasil'yev, G. A. Dorofeyev, V. I. Petrov, M. I. Pimenov, and V. F. Shevchenko 7 Aug. 1967 12 p refs Transl. into ENGLISH from Soyuzn. Nauchn.-Issled. Inst. Priborostr. Dokl., no. 3, 1966 p 22–25

(FTD-HT-23-816-67; AD-662842)

A study is made of the calibration of neutron radiometers with energies close to 2.5 and 14 MeV, formed during nuclear reactions D(d, n)He3 and T(d, n)He4 respectively. A neutron NG-200 generator was used as the accelerator. It was found that in some cases, neutrons from reaction T(d, n)He4 can be used to adjust instruments intended to register neutrons from reaction D(d, n)He3. The calibration error of neutron radiometers for both reactions was calculated as being the sum of the mean square errors in the determination of the neutron flux density and the readings of the calibrated instrument, and was of the order of 5 to 10%. Author (TAB)

N68-16713# Federal Aviation Agency, Atlantic City, N. J. National Aviation Facilities Experimental Center.

WEATHER EFFECTS ON VORTAC FACILITIES VOR MONITOR DETECTOR TESTS Final Report

Jack A. Muller Dec. 1967 33 p

(NA-67-10; RD-66-86)

On this phase of the project the effects of various ice and/or snow conditions on four different monitor detectors, with five different detector covers, were investigated to determine action to be taken in the field to eliminate or reduce VOR outages. Tests were conducted at the NAFEC Experimental VORTAC and the NAFEC Environmental Laboratory. Field and laboratory tests results indicated action to be taken in the field as follows: (1) All adjustable antenna end-loading discs should be set at 2 inches from the ends of the standard cover. (2) If outages still persist after implementation of recommendation #1, or if insufficient signal is provided to the monitor, then the standard cover should be replaced with one 24 inches in length. This extended cover must also be provided with a bottom cover. (3) The VOR Antenna Shelter Type-3 should be provided with a counterpoise mounting base and installed at VOR sites that report the 24-inch cover is not adequate due to extreme weather conditions. Author

N68-16730# Syracuse Univ. Research Inst., N. Y. Civil Engineering Dept.

PHOTOGRAMMETRIC FILM SHRINKAGE TRANSFORMATIONS Final Report, 27 Jun. 1966–27 Aug. 1967

Lee U. Bender and James R. Tremlett Griffiss AFB, N. Y. RADC Dec. 1967 51 p

(Contract AF 30(602)-4382)

(RADC-TR-67-553; AD-663252)

This study is an analysis of five different types of film shrinkage transformations, all of which employed the method of least squares, and applicable to the photogrammetric problem of obtaining reliable photographic measurements. The five transformations examined were: (1) similarity; (2) affine; (3) projective; (4) hyperbolic; and (5) higher. Some special considerations are given as well as numerical results. These concern some assumptions implicit in, and some considerations as to objectives, of film shrinkage investigations. Author (TAB)

N68-16739# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

PROPORTIONAL COUNTER FOR SPACE AND HIGH ALTITUDE DOSIMETRY APPLICATIONS

G. W. R. Endres, W. A. Glass, and A. J. Haverfield 9 Oct. 1967 10 p Presented at the 14th Nucl. Sci. Symp., Los Angles, 31 Oct.–2 Nov. 1967 Submitted for publication
(Contract AT(45-1)-1830)
(BNWL-SA-1364; CONF-671026-2) CFSTI: HC $3.00/MF $0.65

From 14th Nuclear Science Symposium, Los Angeles, Calif. The design and performance of spherical tissue-equivalent proportional detectors for measuring the absorbed dose of gamma radiation and neutrons are presented. Dose distribution and LET data are included. NSA

N68-16811# Centre National de la Recherche Scientifique, Meudon (France). Lab. d'Aerothermique.
INSTALLATION AND INTRODUCTION INTO SERVICE OF A TEMPERATURE CALIBRATION ROOM [INSTALLATION ET MISE EN SERVICE D'UNE SALLE D'ETALONNAGE DE TEMPERATURE]
Gia Ban Diep and Gerald Poissant Jul. 1967 20 p In FRENCH
(Rept.-67-5) CFSTI: HC $3.00/MF $0.65

For the moment, the facilities provided by this calibration room enable temperatures between 40°C and 200°C to be calibrated with an accuracy of 0.001° in the case of relative measurements, and of 0.01° in the case of absolute measurements. This is, in general, quite adequate for laboratory measurements. Those who require less accuracy may also use the room, but in this case the calibration will be more rapid. The only examples of calibration given are confined to thermocouples and thermistances, but the equipment may also be used for any other kind of thermometer. ESRO

N68-16838*# Lockheed Electronics Co., Houston, Tex.
ANALYSIS OF LUNA 9 PHOTOGRAPHY
Washington NASA Feb 1968 88 p
(Contract NAS9-5191)
(NASA-CR-980; LEC/HASD-671-40-019) CFSTI: HC $3.00/MF $0.65 CSCL 14E

The techniques and procedures used for a detailed scientific evaluation and analysis of Luna 9 spacecraft imagery is presented along with results and conclusions. A discussion is given on the nature and specifications of the spacecraft and its instruments. Included here also are the image transmissions and images received. Detailed descriptions of the image frames are given. These include: scale and panoramic coverage of the frames, azimuth and distances of the image features, size and classification of the surface materials, and size and classification of the visible craters. The procedures and techniques used for the above calculations are discussed. These are discussed as applied to monoscopic panoramas, dihedral mirror images, and stereoscopic panoramas. Author

N68-16867*# National Aeronautics and Space Administration, Washington, D. C.
MUSHROOM-SHAPED TRANSDUCER FOR RECORDING PRESSURE IN A SHOCK TUBE
A. P. Shatilov *In its* Studies in Phys. Gas Dyn. Feb. 1968 p 244–248 refs (See N68-16839 07-12)

Presented is a description of the design and assembly procedure of a mushroom shaped pulse type pressure transducer for recording pressure in a shock tube. Results of static, and dynamic calibrations of the prescribed transducer are reported. Experience derived in working with the mushroom type pressure transducer led to the following conclusions: (1) errors in pressure measurement were 10 to 15% of the measured pressure; (2) the transducer correctly reflects the behavior of the processes at the wall of the shock tube and can be used for mutual monitoring of the two methods (measurement of P(t) and ρ(t) in a fixed cross section of the tube x; (3) the errors in measuring the absolute value of pressure are caused by reflection of elastic waves from the shaped head and the imperfection of the recording equipment; and (4) the shock wave velocity can be determined with the aid of two transducers placed at a certain distance from each other (average velocity of shock wave on a certain portion of the shock tube) with an accuracy of 1.0 to 1.5%. S.C.W.

N68-16879# California Univ., Livermore. Lawrence Radiation Lab.
THE PHOTON FILL-TIME OF A FABRY-PERCT SPECTROMETER
T. J. Burgess 31 Oct. 1967 4 p ref
(Contract W-7405-ENG-48)
(UCID-15224) CFSTI: HC $3.00/MF $0.65

The establishment of the interference structure of the Fabry–Perot transmission spectrometer involves the superposition of multiple partial transmissions. Each partial transmission is delayed in time with respect to the preceding one by an amount equal to twice the photon transit time between the etalons. The spectrometer therefore exhibits a delayed rise-time response to a step function of optical input which is called the photon fill-time. An expression is derived which describes the photon fill-time of the spectrometer. NSA

N68-16888# Weather Bureau, Silver Spring, Md. Equipment Development Lab.
NOTES ON WIND MEASUREMENT
Herman H. Crouser Aug. 1967 26 p refs
(WBTM-EDL-2; PB-175774) CFSTI: HC $3.00/MF $0.65

These notes cover a test report on type F420-C high-speed anemometer cup-rotors, fabricated from corrosion-resistant steel, and with the test results showing the greatest difference between tunnel and indicated speeds to be 1.35 knots; a description of the idealized response characteristics of the standard F420-C cup-rotor to both step and sinusoidal inputs, and the idealized response characteristics of the F420-C direction vane to step input; and the problem of linear calibration of the cup-rotor, arising from approximating a power function by a straight line function, that causes errors in the measurement of miles of passage of wind. Also included is a compilation of information on F420-C wind equipment that has not previously been readily available. Author

N68-16903*# Nassau Instrument Co., Princeton, N. J.
A HYDROGEN AIR DETECTOR SUITABLE FOR USE ABOARD SPACECRAFT Final Report
Robert J. Levine Dec. 1967 58 p refs
(Contract NAS8-20597)
(NASA-CR-61536) CFSTI: HC $3.00/MF $0.65 CSCL 14B

An investigation was made of the conditions which could support ignition of hydrogen-air mixtures aboard a spacecraft. It was found that ignition of H_2/Air mixtures is a weak function of temperature and can be made to occur at altitudes as high as 120,000 ft, if sufficient ignition energy is supplied and if areas large enough to contain the ignited globule exist so as not to extinguish the ignition by wall quenching. A catalytic type sensing system was developed which was shown to be capable of detecting 0.04% hydrogen air (1% LEL), was temperature and flow insensitive, but did respond to altitude changes. Recommendations for further improvements of the sensor to eliminate the altitude and contamination sensitivities are included. Author

N68-16923# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
REDUCTION OF THE DURATION OF THE NATURAL DEAD TIME OF A 4 π GAS IONIZATION COUNTER OPERATING IN GEIGER–MUELLER [REDUCTION DE LA DUREE DE L'ETAT D'INSENSIBILITE NATURELLE D'UN COMPTEUR A IONISATION GAZEUSE DE GEOMETRIE 4 π TRAVAILLANT EN REGIME DE GEIGER–MUELLER]
Antoine Becker Jul. 1967 100 p refs In FRENCH
(CEA-R-3189)

It is possible to benefit from the 100 percent efficiency of a 4π gas-ionization detector operating in the Geiger–Mueller regime (an efficiency which always appears difficult to attain in

other detectors) if one is able to reduce considerably and to fix very precisely the length of the real dead time of the system operating in the above conditions. Taking into account both the phenomena characteristic of the discharge in the regime and the geometrical conditions depending on the operation over a solid angle of 4π, it is shown that with an exterior electronic system for cutting off the discharge in 30 nanoseconds, absolute 4π GM measurements would become competitive with those now carried out almost exclusively in proportional conditions. Measurement results on sources of 5×10^{3} emissions per second maximum obtained by the use of a system for which the interval between the passage of a particle and the moment when the device has been made insensitive is still 60 nanoseconds, have made it possible to confirm these statements. Author (NSA)

N68-17014# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INFRARED PHOTOGRAPHY
I. B. Levitin 27 Apr. 1967 162 p refs Transl. into ENGLISH of the book "Fotografiya y Infrakrasnykh Luchakh" (Moscow), Voyennoye Izd. Min. Oborony Soyuza SSR, 1961 p 1–192
(FTD-MT-65-187; AD-663365)

The book gives an accessible form the basis of infrared photography with special interest in the necessity of photographing at considerable distances and under poor conditions of visibility. The nature and sources of infrared rays (utilized for photography), their passage through the atmosphere, the principles of infrared photography and the methods of processing are examined. Examples are given of the military application of infrared photography in the Soviet Union and abroad. The book is intended for a wide range of readers who are interested in the problems of infrared photography. The Chapters in this document are as follows: Chapter I. Fundamental Information on Infrared Rays and Their Properties; Chapter II. Principles of Infrared Photography; Chapter III. Photographic Materials for Infrared Photography; Chapter IV. Treatment of Photographic Materials for Infrared Photography; Chapter V. Technology of Infrared Photographing; Chapter VI. Application of Infrared Photography in the Military. TAB

N68-17048# Minnesota Univ., Minneapolis. Observatory.
PROPER MOTION SURVEY WITH THE FORTY-EIGHT INCH SCHMIDT TELESCOPE. 12: SEVEN FAR NORTHERN REGIONS
William J. Luyten 1 Mar. 1967 41 p
(Grants NSF G-22254; NSF GP-4309)
(PB-175946) CFSTI: HC $3.00/MF $0.65

In continuation of the regions reported on in Nos. IV and IX of this series the present publication gives data for 2816 proper motion stars found in six circumpolar regions and one region at declination +48. Author

N68-17052*# Sylvania Electronic Products, Inc., Mountain View, Calif.
A PORTABLE LASER INSTRUMENT FOR VIBRATION ANALYSIS AND TRANSDUCER CALIBRATION
G. A. Massey and R. R. Carter [1967] 16 p
(Contracts NAS2-3643; NAS2-4176)
(NASA-CR-73137) CFSTI: HC $3.00/MF $0.65 CSCL 14C

The design and performance of a 6328 Å laser heterodyne system providing sensitive, broadband measurement of vibrations of mechanical structures and electromechanical transducers is described. Using this device, it is not necessary to attach any mass to the vibrating object. A single frequency laser is used as the source, and a liquid acoustic diffraction cell is used to shift the frequency of the reference or "local oscillator" beam in an interferometer. A second unshifted beam is reflected from the vibrating surface. When the reflected and shifted beams are combined on a photodetector, a beat frequency at 25 MHz is produced. Periodic motions of the reflecting surface then produces modulation sidebands about the 25 MHz difference or intermediate frequency. Equal phase shifts on the reflected light and on the intermediate frequency are produced by the motion. Thus the amplitude and frequency of the vibration can be recovered by demodulation of the phase-modulated 25 MHz signal, or by direct measurement using an ordinary radio-frequency spectrum analyzer. The 25 MHz frequency offset removes the directional ambiguity of the Doppler shift usually found in interferometer devices of this type. Author

N68-17064*# Princeton Univ., N. J. Dept. of Aerospace and Mechanical Sciences.
CAPACITIVE PRESSURE TRANSDUCER SYSTEM
Gerard J. Born, Enoch J. Durbin, and Robert S. Quinn Jul. 1967 133 p refs
(Contract NAS8-5343)
(NASA-CR-61539) CFSTI: HC $3.00/MF $0.65 CSCL 14B

The design and analysis of a closed loop capacitive pressure transducer with extended frequency response for accurate low pressure measurements are discussed. Theoretical considerations are given to a forward loop transducer and to the effects of closing the loop with an electrostatic feedback loop around the transducer. The frequency and dynamic response synthesis and an analog simulation study were also investigated. A closed loop system was experimentally constructed to verify the theory. The open loop analysis showed that the frequency of the membrane is directly proportional to the squre root of the radial tension, its sensitivity is inversely proportional to the tension, and the performance is dependent upon its mechanical properties. It was established that a feedback system's performance could be made independent of the mechanical properties by employing a weakly stressed diaphragm. It was determined that the properties are identical for an open loop highly stressed diaphragm and a closed loop low stressed diaphragm. The open loop system is considered preferable for measuring pressures above 10^{-3} mm Hg and the closed loop system for lower pressures. N.E.N.

N68-17069*# Sylvania Electric Products, Inc., Mountain View, Calif. Electronic Defense Labs.
LASER VIBRATION ANALYZER
Gail A. Massey Dec. 1967 64 p refs
(Contract NAS2-4176)
(NASA-CR-73167) CFSTI: HC $3.00/MF $0.65 CSCL 14B

This report describes a development program for the purpose of designing, fabricating, and testing a prototype laser vibration measuring instrument. During two previous study efforts, the optical heterodyne technique was selected as the most promising method for remote measurement of vibrations over a wide range of amplitudes and frequencies. The prototype instrument is designed to operate at a distance of three feet from the vibrating surface. The output beam is focused on the surface and can be scanned manually by means of a rotatable steering mirror. The output of the device is a frequency-modulated signal centered at 25 MHz; the phase shift of this signal is proportional to surface displacement. Vibration frequencies from 1 Hz to 0.5 MHz have been measured with this instrument, with displacements from 1/2 inch peak-to-peak down to approximately 10^{-4} microns. The surface may be specular or diffusely reflecting. This instrument is designed for use with a spectrum analyzer as the display device; however, means for operating the laser vibration analyzer with a tunable voltmeter or FM receiver for signal demodulation and recording are also described. Author

N68-17152# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.
COMPENSATED-POWER DIFFERENTIAL CALORIMETER FOR −196°C TO 400°C [CALORIMETRE DIFFERENTIEL A PUISSANCE COMPENSEE −196°C/400°C]
Emmanuel Bonjour, Jacques Pierre, Serge Agagliate, Pierre Bertrand, Jean Faivre et al Jun. 1967 59 p refs In FRENCH
(CEA-R-3181)

A differential calorimetric device of original design is described. It allows direct measurements of thermal effects (adsorption or release) during a linear rise of temperature. The self compensated power method which is applied by means of a very sensitive control system, gives a direct value of the differential heat capacity between the sample and a dummy of it. The detection threshold is about ±100 to ±250 microwatts. The applications of the colorimeter are generally measurements of enthalpy changes in massive or powdered samples, measurements of Wigner energy after low temperature irradiation (77°K), and measurements of energy releast in low temperature (77°K) cold worked metals. Author (NSA)

N68-17202 Perkin-Elmer Corp., Norwalk, Conn. Optical Group.
NEW DEVELOPMENTS IN INTERFEROMETRY
1967 65 p refs Symp. held at Norwalk, Conn., 21 Sep. 1967

CONTENTS:

1. MULTIPLE BEAM INTERFEROMETRY H. D. Polster 6 p ref (See N68-17203 07-14)
2. HOLOGRAM-INTERFEROMETRY J. Pastor 16 p refs (See N68-17204 07-14)
3. SCATTER PLATE INTERFEROMETRY R. M. Scott 9 p refs (See N68-17205 07-14)
4. INTERFERENCE PHASE MEASUREMENT R. Crane 8 p (See N68-17206 07-14)
5. DUAL INTERFEROMETRY P. Langenbeck 14 p refs (See N68-17207 07-14)
6. MULTIPLE WAVELENGTH INTERFEROMETRY WITH TUNABLE SOURCE R. Pilston and G. Steinberg 8 p refs (See N68-17208 07-14)

N68-17203 Perkin-Elmer Corp., Norwalk, Conn. Optical Group.
MULTIPLE BEAM INTERFEROMETRY
H. D. Polster *In its* New Develop. in Interferometry 1967 6 p ref (See N68-17202 07-14)

Differences between Fabry–Perot and Fizeau fringes in multiple beam interferometers are described. Resolution criteria such as finesse and the maximum slope on the fringe profile are discussed with respect to their use in evaluating the resolution capabilities of the Fizeau interferometer. The advantages of multiple beam interferometry are discussed. They are extended to spherical multiple waves as well as plane waves. The increased accuracy obtainable with the Fizeau type multiple beam interferometer is associated with several factors. Properly applied, the instrument offers excellent accuracy in evaluating optical surfaces and image forming systems. L.S.

N68-17204 Perkin-Elmer Corp., Norwalk, Conn. Optical Group.
HOLOGRAM-INTERFEROMETRY
J. Pastor *In its* New Develop. in Interferometry 1967 16 p refs (See N68-17202 07-14)

Equations describing the interference of waves in hologram interferometers are presented. The application of this technology to optics is discussed. The generation of a diffraction grating by interference; the reconstruction of a hologram; and the generation of a six wavefront single exposure hologram interferometer are discussed, with accompanying schematic diagrams of the systems. Other diagrams outlining systems of double exposure; two-hologram systems; three lenses of similar characteristics and aberrations; and synthetic hologram systems, are also presented, and are discussed. Zero and first order fringes occurring in single exposure hologram interferometry are also discussed. L.S.

N68-17205 Perkin-Elmer Corp., Norwalk, Conn. Optical Group.
SCATTER PLATE INTERFEROMETRY
Roderic M. Scott *In its* New Develop. in Interferometry 1967 9 p refs (See N68-17202 07-14)

The development of the scatter plate interferometric method for the testing (during final figuring) of the 36-inch diameter paraboloidal primary and 14-inch diameter ellipsoidal secondary mirrors for Stratoscope 2, a large high resolution photographic telescope flown by balloon at an elevation of about 80,000 ft, is discussed. Schematic diagrams of scatter plate-mirror systems are presented, along with equations applicable to these systems. Several fringe patterns obtained with the tests are presented. L.S.

N68-17206 Perkin-Elmer Corp., Norwalk, Conn. Optical Group.
INTERFERENCE PHASE MEASUREMENT
Robert Crane *In its* New Develop. in Interferometry 1967 8 p (See N68-17202 07-14)

The concept of the phase measuring interferometer is discussed. The instrument consists of a conventional two beam interferometer in which the fringe pattern is analyzed electronically. A diagram illustrating the operation of a simple Twyman–Green interferometer with a collimated, plane-polarized monochromatic source, is given. Representations of the behavior of an electric vector for right hand, circularly polarized light are presented. The optical schematic of a frequency shifter is depicted. A phase measuring interferometer developed as a sensor in the control system for an active optics experiment, is described. In the application of this interferometric system, it was possible to generate nine error signals for alignment of the three mirror segments. Photographs of the fringe patterns which were generated subsequent to automatic alignment, are depicted. L.S.

N68-17207 Perkin-Elmer Corp., Norwalk, Conn. Optical Group.
DUAL INTERFEROMETRY
Peter Langenbeck *In its* New Develop. in Interferometry 1967 14 p refs (See N68-17202 07-14)

Moire; fringe sharpening; and sensitivity miltiplication approaches to interferometric metrology, are discussed. Each approach involves the coupling of two interferometers such that a hybrid interferogram is produced. The technique is called dual interferometry. Surface slope measurements and homogeneity are evaluated. The effects obtained with Twyman–Green and Fizeau interferometers are discussed. An analysis of multiple-beam fringe sharpening is made. The principle of the multipass dual interferometer is discussed, and applications of the instrument are suggested. The determination of component aberrations in a multipass interferometer is discussed. Other details of these dual interferometric systems are also considered. L.S.

N68-17208 Perkin-Elmer Corp., Norwalk, Conn. Optical Group.
MULTIPLE WAVELENGTH INTERFEROMETRY WITH TUNABLE SOURCE
Robert Pilston and George Steinberg *In its* New Develop. in Interferometry 1967 8 p refs (See N68-17202 07-14)

The position and frequency lock-ons to the fringes of patterns produced in a Fizeau interferometer in which the multiple wavelengths are produced in sequence by a tunable single mode laser, are discussed. A schematic optical diagram of the interferometer, an assembly drawing, a schematic optical diagram and an assembly drawing of the interferometer, are depicted; along with a photograph of the actual instrument in an environmental chamber. Of the three frequency stabilized laser beams used in the instrument, one is used to illuminate the full aperture of the primary interferometer, and the remaining two are used to illuminate three secondary lock-on interferometers need to servo control the spacing between the reference and test mirrors of the primary interferometer. A schematic diagram of the electro-optical frequency servo system is depicted. Other details of the instrument are also given. L.S.

N68-17210# Naval Civil Engineering Lab., Port Hueneme, Calif.
BETA-RAY BACKSCATTERING GAGE FOR MEASURING PAINT FILM THICKNESS Final Report, Oct. 1966–Mar. 1967

F. W. Brown, III Dec. 1967 25 p refs
(NCEL-TR-553; AD-663130) CFSTI: HC $3.00/MF $0.65

An experimental nondestructive paint thickness gage using the backscattered beta radiation from Sr-Y-90 was developed. This gage will measure a variety of commonly used paints having thicknesses ranging from 0.5 to about 30 mils on wood with an error of approximately plus or minus 0.5 mil. Graphs are given demonstrating the performance of this gage in measuring the thickness of films of various federal specification paints (TT-P-102, TT-P-0055a, TT-E-489) and Paint A, a proprietary paint. Author (TAB)

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N68-16108*# Lockheed-Georgia Co., Marietta.
NONDESTRUCTIVE TESTING FOR EVALUATION OF STRENGTH OF BONDED MATERIALS (METALLIC) Bibliographic List
Sherman E. Cohen 1 Sep. 1966 76 p refs
(Contract NAS8-20627)
(NASA-CR-61503) CFSTI: HC $3.00/MF $0.65 CSCL 13H

Details are given on the equipment and procedures developed for applying, testing, and photographically recording the results of thermographic tests using a liquid crystal heat sensitive coating that changes color with minute temperature gradients, caused by discontinuities, in the substrate structure. Test specimens with built-in flaws represent 52 variations of materials and construction types used in aerospace structural composites. Special instrumentation for the calibration and quality checking of liquid crystals is also described. Results show that system effectiveness is dependent upon the particular construction of the bonded honeycomb panel or laminate to be inspected, and the size, type and location of the defect. A bibliographic list is included on the non-destructive testing for evaluation of strength of bonded metallic materials, and selected abstracts from this list are presented. B.S.D.

N68-16167# Institut Franco-Allemand de Recherches, St. Louis (France).
REVIEW OF THE DEVELOPMENTAL PROCESSES FOR PREPARING FLEXIBLE EXPOSIVES AT THE ISL [UEBERSICHT UEBER DIE IM ISL ENTWICKELTEN VERFAHREN ZUR HERSTELLUNG FLEXIBLER SPRENG-STOFFE]
W. Kegler 24 Nov. 1966 73 p refs In GERMAN
(ISL-8/66)

This survey depicts the following fabrication methods for manufacturing rubber bonded sheet explosives: (1) casting with latex, (2) solvent extraction with rubber; and (3) extraction with deresinated rubber. Graphic illustrations of fabrication processes and photos are included and the advantages and disadvantages of the methods and their end products are discussed. Mixtures of rubber, pentaerythritetetranitrate, hexogen, octogen, and ammonium nitrate are used to produce explosive foils, ribbons, and strings with a detonation velocity of 3600 to 8000 m/s at a density of 0.75 to 1.50 g/cm^3. These products have a tearing strength of about 2 to 20 kp/cm^2 and a fracture elongation of 150 to 350%. Author

N68-16198# Central Mechanical Engineering Research Inst., Durgapur (India).
THEORETICAL INVESTIGATION INTO THE QUANTITATIVE ANALYSIS OF VIBRATION DAMPING IN FLUID COUPLING
Pulak De Jul. 1967 10 p refs Presented at the 10th Congr. on Theoret. and Appl. Mech., Madras, 25–31 Dec. 1965
(B2)

The problem of torsional vibration damping fluid coupling has been previously studied in certain linear cases assuming low values of slip. In this paper, the case of monotonous viscous damping has been discussed without the said assumption. A quantitative expression relating to the impeller and turbine side vibration amplitudes and frequencies has also been shown to exist. Author

N68-16200# National Lead Co. of Ohio, Cincinnati. Technical Div.
ROTARY PIERCING OF URANIUM
H. W. Hesselbrock, H. Davis, and C. E. Polson Oct. 1967 53 p refs
(Contract AT(30-1)-1156)
(NLCO-991) CFSTI: HC $3.00/MF $0.65

Uranium billets were rotary-pierced in the high alpha temperature range on a modified three-roll No. 1 Witter mill. Rolled and extruded billets were used as feedstock. They were heated in a muffle furnace under a protective atmosphere of argon. Evaluations were made of the effects of billet preheat temperature, roll speed, roll cooling, and type of feedstock. Problems with eccentricity and undesirable grain structures experienced in previous tests were corrected. Pierced uranium tubes were produced having uniform, fine grain structures, smooth surfaces, and acceptable dimensional variations. Author (NSA)

N68-16235# Central Mechanical Engineering Research Inst., Durgapur (India).
INDIGENOUS DYE-PENETRANTS
S. G. N. Swamy Feb. 1967 8 p
(A8)

A dye-penetrants set was developed. The technique of application of the penetrant and other accessory solutions for detection of surface flaws are discussed. Author

N68-16363# Bettis Atomic Power Lab., West Mifflin, Pa.
SOME PROBLEMS AND NEW WELDING TECHNIQUES APPLIED TO THE CONSTRUCTION OF NUCLEAR REACTORS
Henry Foulquier [1967] 27 p Transl. into ENGLISH from Bull. Inform. A.T.E.N. (Paris), no. 63, 1967 p 32–43
(WAPD-TRANS-76) CFSTI: HC $3.00/MF $0.65

Problems in welding encountered chiefly in the design of the EL4 heavy water–gas reactor are discussed. The problems included welding the ends of the Zr alloy force tubes to the orthocylindrical stainless steel tank bottoms, performance of overlap welds, fabrication of double bottoms, and remotely controlled welding machines. Author

N68-16468*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
FRICTION TORQUE OF BALL BEARINGS IN VACUUM WITH SEVEN POLYTETRAFLUOROETHYLENE COMPOSITION RETAINER MATERIALS
Herbert W. Scibbe, Dean C. Glenn, and William J. Anderson Washington Feb. 1968 20 p refs
(NASA-TN-D-4355) CFSTI: HC $3.00/MF $0.65 CSCL 13I

Self-lubricating retainer materials containing various weight percentages of polytetrafluoroethylene (PTFE), glass fibers, molybdenum disulfide (MoS_2), and bronze were evaluated in 20-millimeter-bore ball bearings operating in a vacuum of 10^{-8} torr (1.33×10^{-4} N/m^2). The lubricating capability of the retainer materials was evaluated by measurement of the bearing friction torque. The test bearings were run at 3600 rpm with axial loads from 35 to 100 pounds for periods of approximately 1 hour. Although all retainer materials lubricated the bearings reasonably well, the best lubrication, as measured by the lowest average friction torque, was obtained with a bearing equipped with a retainer of

70 percent PTFE, 15 percent glass fibers, and 15 percent MoS_2. In an initial run at a load of 50 pounds with this material, the bearing torque was high and erratic; in the next three consecutive runs, however, the torque remained at a low, constant level. In the following three consecutive runs, the bearing registered low, steady torque upon restart and thereby demonstrated good restart capability. During the time intervals of 24 hours or more between the runs, the bearing "soaked" in the vacuum chamber. The good performance with this retainer was partly attributed to a fabricating process that produced a homogeneous mixture of PTFE, glass fibers, and MoS_2 in the material. Author

N68-16485# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratorio Gas Ionizzati.
VERY HIGH PRESSURE FAST VALVE
M. Haegi May 1966 12 p refs
(LGI-66/4)

A fast valve was designed for feeding the nozzle which is used in forming a hollow cylindrical gas shell for Z-pinch studies. The valve connects the high-pressure room with the stagnation room of the nozzle. The valve requirements are an opening velocity of several m/sec and an operating time of $\approx 10^{-3}$ sec. Results of dynamic measurements on the valve are given. NSA

N68-16602# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EFFECT OF THE NUMBER OF ROTOR BLADES ON THE CHARACTERISTICS OF AN AXIRADIAL COMPRESSOR
A. N. Sherstyuk and Ye. N. Zaychenko 15 Jun. 1967 16 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Aviats. Tekh. (Kazan), no. 4, 1965 p 125–132
(FTD-HT-66-769; AD-663359)

A series of experiments were conducted to determine the effect of the number of blades on the performance characteristics of a mixed-flow compressor with an exit blade angle of 90 degrees. The obtained results show that for a compressor with a rotor diameter on the order of 130 mm, the optimum number of blades is about 14. A reduction in the number of blades results in an increase in the optimum discharge coefficient phi. For example, when the number of blades is reduced from 14 to 4, phi increases from 0.23 to 0.25. This increase is due to the decrease in the angle of attack, since the latter is directly proportional to the number of blades. The presented curves can be used to calculate compressor performance characteristics. TAB

N68-16630# Battelle Memorial Inst., Richland, Wash. Pacific Northwest Lab.
APPLICATION OF SPUTTERING TO THE FABRICATION OF NEUTRON DETECTOR ANODES
E. D. McClanahan, R. W. Moss, and R. Busch Nov. 1967 17 p refs
(Contract AT(45-1)-1830)
(BNWL-553) CFSTI: HC $3.00/MF $0.65

Triode sputtering was selected for application to a fabrication process. The sputtering process is discussed in terms of the variables and techniques available to obtain desired product characteristics. Some problems that are encountered in the application of sputtering to fabrication are considered. An experimental project concerned with the fabrication of neutron detector anodes is reported as an example of the application of the sputtering process. The anodes, which consisted of uranium coated stainless steel cylinders, were successfully produced by this technique. Author (NSA)

N68-16685*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
LUBRICATION OF SLIDING AND ROLLING ELEMENT ELECTRICAL CONTACTS IN VACUUM
John Przybyszewski Washington 1968 34 p refs To be presented at the Ann. Meeting of the Am. Soc. of Lubrication Engr., Cleveland, 6–9 May 1968
(NASA-TM-X-52382) CFSTI: HC $3.00/MF $0.65 CSCL 11H

Sliding electrical contact problems in vacuum, and recent experiments in this field are reviewed in regard to the lubricants used. Attention is given to the relationship between surface contamination and the wear of graphite. Organic lubrication is reviewed and it is seen as an undesirable method of lubricating electrical contacts on the basis of the friction polymer data examined. Brief conclusions are drawn regarding the performance of the various lubricants on the basis of the experimental evidence. Thin, metallic films are seen as a promising method of contact lubrication, and several excellent methods of depositing these films are presented. Author

N68-16779*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PRELIMINARY EVALUATION OF GREASES TO 600°F AND SOLID LUBRICANTS TO 1500°F IN BALL BEARINGS
H. E. Sliney and R. L. Johnson Washington 1968 22 p refs To be presented at the Ann. Meeting of the Am. Soc. of Lubrication Engr., Cleveland, 6–9 May 1968
(NASA-TM-X-52384) CFSTI: HC $3.00/MF $0.65 CSCL 11H

A special apparatus designed for the evaluation of high temperature lubricants in 20 mm bore ball bearings is described. The results of bearing runs at temperatures up to 1500 F in air are reported. Of the greases evaluated, a fluorocarbon grease, provided bearing lubrication for longer times at 450 and 600 F than eigher polyphenyl ether or silicone greases thickened with dyes and/or MoS_2. Cobalt alloy ball bearings, lubricated either with barium fluoride–calcium fluoride coatings bonded to the cages or with porous metal cages impregnated with these fluorides, ran successfully at 1200 and 1500 F under a thrust load of 30 pounds and at a shaft speed of 5000 rpm. Author

N68-16901*# IIT Research Inst., Chicago, Ill.
VACUUM TEST OF INSTRUMENT SIZE GEARS Progress Report, 22 Jun. 1965–1 Aug. 1967
Jerry Farrell et al 1 Aug. 1967 104 p refs
(Contract NAS5-10301)
(NASA-CR-92665) CFSTI: HC $3.00/MF $0.65 CSCL 13I

This report describes the experimental facilities developed for the evaluation of 8 different materials using 304 gears (involute profile) and 32 gears (cycloidal profile) as the test component. Brief descriptions are given of the four-square gear test rigs, master gear arrangements and instrumentation for the measurement of wear rates. The first series of material evaluations using the involute gears at constant speed (1800 rpm) and torque load (20 oz-in.) have been completed and these results are presented in this report. These tests included 14 atmospheric tests and 42 tests conducted in vacuum. The evaluation results of 8 materials in the 224 involute gears indicate that the nitrided Nitralloy and 440C stainless steel material combinations operated for the prescribed time (720 hours) in both laboratory and vacuum atmosphere. The Martin hard coated 7075 aluminum alloy and the nitrided Nitralloy materials combination as well as the Martin hard coated 7075 aluminum alloy and C-1085 steel silver plated with MoS_2 "in situ" combination operated for the prescribed time in vacuum only. In the laboratory evaluations, the nitrided Nitralloy and phosphor bronze –15% MoS_2 matrix material combination operated for the prescribed time. Author

N68-17099*# Boeing Co., Seattle, Wash. Missile and Information Systems Div.
DEVELOPMENT OF MANUFACTURING TECHNIQUES FOR APPLICATION OF HIGH PERFORMANCE CRYOGENIC INSULATION Final Report, Jun. 21–Oct. 20, 1967

C. L. Lofgren and D. E. Gieseking 20 Oct. 1967 58 p refs
(Contract NAS8-21172)
(NASA-CR-61557; D2-109005-1) CFSTI: HC $3.00/MF $0.65
CSCL 13H

This report details the design study and the development of manufacturing techniques for insulating an existing 200-inch diameter Torus Tank detailed in MSFC Drawings. The design criteria for the high performance insulation system was that it have a thermal conductivity of 5×10^{-5} Btu/hr.-ft.-°R, a density of 1.5 pounds per cubic foot, a thickness of 5 to 6 inches, and good manufacturing producibility and repeatability. The system was required to withstand the acoustic, vibration, and acceleration loads typical of the Saturn V vehicle. The result of the program is a detailed high performance insulation design and manufacturing plan for the Torus Tank. Author

N68-17126# Acieries Reunies de Burbach-Eich-Dudelange S. A., Luxembourg.
THE USE OF RADIOISOTOPES IN THE FOUNDRY [LES APPLICATIONS DES ISOTOPES RADIOACTIFS DANS LA FONDERIE] Final Report
H. Hencks, E. Ney, and H. Wagner Brussels EURATOM Nov. 1967 28 p refs In FRENCH; ENGLISH summary
(Contract EURATOM-037-64-8 IRAL)
(EUR-3645.f)

The paper describes procedures and measuring methods applied to the use of radioisotopes in the steel foundry. The research aims at nondestructive testing of steel castings having a mean thickness of about 400 mm, in order to investigate problems of liquid metal convection, solidification and contraction. The results will promote the manufacturing of homogeneous castings having a minimum of blowholes and porosites. A first part is devoted to the working procedures and preliminary experiments. A second part deals with the phenomena of convection and solidification in the case of the manufacturing of relatively thin walled slag ladles. Finally the paper describes the mixing problems encountered in annular castings where two pouring ladles charged by two different furnaces are used. Author

N68-17151# Mechanical Technology, Inc., Latham, N. Y.
STEAM LUBRICATION STUDIES. PART 1: EXPERIMENTAL INVESTIGATION OF A STEAM LUBRICATED JOURNAL BEARING
Fred K. Orcutt, Denis E. Dougherty, and Stan B. Malanoski Nov. 1967 78 p refs
(Contract N00014-66-C-0214)
(MTI-67TR76; AD-663177)

A combined experimental and analytical investigation was initiated for the purpose of developing design data and guidelines for steam lubrication of naval machinery. The report on experimental studies of the steam lubricated journal bearing, is one of three being issued to describe the results of the program. The experiments showed that steam-lubricated bearings can be operated satisfactorily with a saturated or high-quality steam supply. Moreover, they can be operated in a low-temperature environment and without need for external sources of heat, other than the steam itself. The most critical problem in the operation of these bearings is steam hammer instability which appears to be caused by evaporation of entrained moisture in the bearing film. The report describes bearing design features, steam supply system requirements and operating condition limitations which resulted in satisfactory, stable, operation with pressure ratios from 3 to 15 and for a wide range of steady-state loads and shaft speeds. Author (TAB)

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N68-16152# Institut Franco-Allemand de Recherches, St. Louis (France).
SOME EXAMPLES OF THE APPLICATION OF LASERS IN BALLISTIC RESEARCH [EINIGE BEISPIELE ZUR ANWENDUNG DES LASERS IN DER BALLISTISCHEN FORSCHUNG]
K. Vollrath 5 Nov. 1966 51 p refs In GERMAN
(ISL-T-31/66)

Various laser types are described and the use of ruby lasers for photographic recordings of self illuminating processes by Schlieren or schadow techniques is outlined. Also discussed is laser applications in aeroballistic tunnels, in cenematography, holography, and interferometric velocity measurements. The last chapter covers plasma and shock wave generators, and the triggering of explosive materials by focused laser rays. Author

N68-16369*# Electro-Optical Systems, Inc., Pasadena, Calif.
STUDY OF ATMOSPHERIC DEGRADATION OF LASER BEAMS Final Report, 1 Jun. 1966–31 May 1967
J. Boyden, L. Carrier, G. Clark, E. Harris, M. Katzman, et al Dec. 1967 118 p refs
(Contract NAS12-130)
(NASA-CR-86030; EOS-7097-Final) CFSTI: HC $3.00/MF $0.65
CSCL 20E

A summary of the current state of theoretical understanding of the interaction of optical radiation with the atmosphere is presented along with an extensive bibliography. Particular attention is given to scattering and attenuation due to particulate matter contained in the atmosphere, and also to amplitude and phase fluctuations induced by atmospheric turbulence. An assembly of equipment to measure meteorological parameters, along with optical transmission parameters of the atmosphere, and with some preliminary measurements are presented. This includes an optical link over a 5 km path in the lower atmosphere and having each end of the link instrumented for the collection of meteorological data. Author

N68-16459# Cornell Univ., Ithaca, N. Y. Lab. of Atomic and Solid State Physics.
TWO-PHOTON PHOTOELECTRIC SPECTROSCOPY IN CSI
E. M. Logothetis 22 Nov. 1967 12 p refs
(Contract Nonr-401(47))
(Rept.-838; TR-20; AD-663163)

The two-photon photoelectric effect spectrum of a cesium iodide film was obtained using a Q-switched ruby laser and a Xe flashlamp as the light sources. TAB

N68-16618# Navy Electronics Lab., San Diego, Calif. Center for Command Control and Communications.
SATURATION FLUX AND STIMULATED EMISSION CROSS SECTION OF THE CO_2 LASER Research and Development Report, Nov. 1966–Jul. 1967
David F. Hotz and Joseph W. Austin 11 Oct. 1967 16 p refs
(NELC-1518; AD-663270)

Development of a high radiance laser source is a necessary preliminary to study of nonlinear phenomena in the gases of a typical atmosphere. Before an efficient laser power amplifier can be designed, two gain limiting effects must be understood: gain saturation and spectral hole-burning. Gain saturation flux and stimulated emission cross section for the strong laser transition in CO2 were measured. The saturation flux was found to be 22 (+2 or -2) W/sq cm for steady state emission. The cross section was found to agree with theory only after correction for participation of appreciable numbers of rotational levels in the gain process. It was concluded that gain linewidth is homogeneously saturable for typical CO2: N2: He mixtures in which pressure exceeds 10 torr, and that hole-burning will not occur until cw flux levels of the order of 100,000 W/sq cm are achieved. Hole-burning will appear at about 10,000 W/sq cm for Q-pulse amplification. Author (TAB)

N68-16639# Defence Standards Labs., Maribyrnong (Australia). Dept. of Supply.

THE TRANSFER EFFICIENCY OF LASER PUMPING CAVITIES WITH DIFFUSELY REFLECTING WALLS

D. R. Skinner Nov. 1966 14 p refs

(DSL-R-292)

A measure of the transfer efficiency of a diffusely reflecting laser pumping cavity has been obtained by subjecting a laser crystal to a pump flash well below threshold, and measuring the slope of a plot of fluorescent output intensity against electrical input energy. The efficiency was measured for four pumping cavities, all identical except for reflectivity. Calculations of the expected efficiency have been made both by the Monte Carlo method and on the assumption that the light inside the cavity was isotropic. The results of the two types of calculation were consistent. No significant differences were found between the experimental results and theory; it may thus be concluded that diffusely reflecting cavities may conveniently be treated as if the light inside the cavity were isotropic. Author

N68-16735# Cornell Univ., Ithaca, N. Y. Materials Science Center.

OPTICAL PARAMETRIC INTERACTION IN ADP

Michael Douglas Magde (M.S. Thesis) Jan. 1968 52 p refs Sponsored in part by ARPA

(Contract Nonr-401(47)M-10)

(MSC-TR-21; MSC-840; AD-663139)

A detailed experimental study was made in ADP of spontaneous parametric interaction. Pumped by a pulsed laser source at 3472A, the parametric output was tuneable from 4400A to 16,000A. The experimental results agree reasonably well with a theory which considers the process as the amplification of quantum noise and which involves explicitly a calculation of the noise input under the present experimental conditions. Author (TAB)

N68-16816# Texas Univ., Austin. Antennas and Propagation Div.

STIMULATED RAMAN EMISSION FROM RAMAN ACTIVE MATERIALS USING A GIANT PULSE RUBY LASER

H. Richard Arons, David L. Dobbins, and Alfred H. La Grone 15 Aug. 1967 65 p refs

(Grant NSF GA-767)

(P-19; PB-175809) CFSTI: HC $3.00/MF $0.65

Many new single-frequency light sources have been made possible by the discovery of stimulated Raman emission. In many cases the requirements of an intense single-frequency light source of specified frequency can now be met. This paper presents the experimental arrangements and equipment used to observe stimulated Raman emission. The first and second Stokes emission lines in benzene were observed in the emission at 90 degrees to the laser beam. The first and second Stokes emission lines in toluene were observed in the emission at 90 degrees to the laser beam. The first, second, and thrid Stokes emission lines in benzene were observed in axial emission. Author

N68-16908# New Mexico State Univ., Las Cruces. Research Center.

VARIATION OF REFRACTIVE INDEX DURING LASER OPERATION

J. R. Izatt, H. A. Daw, and D. Milam Jul. 1967 30 p refs

(Contract Nonr-3531(04))

(TR-5; AD-663143)

The results of a previously reported study of the resonant absorption of the light from a ruby laser by a ruby sample lead to a reinterpretation of our early measurements of the anomalous dispersion associated with the R1 absorption doublet. The revised results are in excellent agreement with the general background refractive index as measured by conventional optical techniques. The deviations from the background index which are associated with R1 absorption are in good qualitative agreement with line shapes measured in the absorption study. A quantitative correlation of absorption and dispersion will require simultaneous measurements of those two quantities. A single mode laser has been designed and constructed which will reduce the complexity of the experimental data from which refractive index values are extracted and materially improve the accuracy of the results. Some experiments are discussed which demonstrate that the intensity ratio of the R1(plus or minus 1/2) and R1(plus or minus 3/2) components of a cooled ruby laser output can be reversed by altering the resonant cavity configuration. Author (TAB)

N68-16910# Weapons Research Establishment, Salisbury (Australia).

LASER RESONATORS, PROPERTIES OF LASER BEAMS AND DESIGN OF OPTICAL SYSTEMS

B. A. See Aug. 1967 39 p refs

(WRE-TN-PAD-134) CFSTI: HC $3.00/MF $0.65

A review of the properties of laser resonators is given with emphasis on the characteristics which determine the optical properties. The geometric properties, divergence, and spot size are determined by the cavity geometry from which the beam originates. Expressions are given which allow design of optical systems for multimode aperture limited beams. Two particularly important parameters are introduced $K = W_o^2/b$ (where W_o is a generalized waist radius for an aperture limited beam, and b the confocal parameter). K is preserved under beam transformations and is a measure of inherent divergence of the beam. A stability parameter S related to K is obtained, by consideration of aperture limited beams, which measures the stability of any resonator relative to the most stable system. A surface of stability is drawn. Profiles of S are used in designing resonators for specified optical properties. S is closely related to the confocal parameter. Author

N68-16942# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.

PULSED METAL-VAPOR LASERS

W. T. Walter *In its* Microwave Res. Inst. Programs Nov. 1967 p 65–68 refs (See N68-16927 07-10)

(Grant NSF GU-1557)

Low lying energy levels of metals and transition metals in the vapor phase are studied for their efficiency as laser media. In order to obtain short pulsed metal vapor discharges, particularly in cooper, a new laboratory is being constructed to study molecular copper compounds in two high temperature tube furnaces capable of producing temperatures up to 1750°C within uniform hot-zone volumes. A schematic diagram of the apparatus is shown. When the excitation of the upper laser level and the relaxation of the lower laser level occur sequentially then an efficient pulsed laser is obtained by cyclic operation of the apparatus. Electron excitation and laser processes in copper indicate its application potential in such a system. G.G.

N68-16943# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.

HIGH FREQUENCY STABILIZATION

J. T. La Tourrette and P. Rabinowitz *In its* Microwave Res. Inst. Programs Nov. 1967 p 69–72 (See N68-16927 07-10)

(Grant NSF GU-1557)

The use of a CO_2 laser as active reference system for wave length and frequency standards is investigated. A proposed stabilization system for the laser compares one portion of its output with the absorption profile of a passive CO_2 absorption cell and develops an error voltage proportional to the difference between the laser oscillation frequency and the absorption line center frequency. A Ge:Au photodetector detects amplitude modulations that result from the conversion of FM to AM as the laser beam traverses the absorption cell; its output signal is amplified and used to complete a stabilization feedback loop. Analysis of the stabilization system signal-to-noise ratio shows that the system true stability is determined by maintaining the line center

precision. A CO_2 laser operating in a sealed, non-flowing condition was constructed and works satisfactorily with an output level of about 2 watts. G.G.

N68-16948# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.
EQUATIONS OF MOTION IN A MULTIMODE LASER AMPLIFIER
P. P. Bertrand, A. Kestenbaum, M. M. Miller, E. A. Mishkin, and D. Stoler *In its* Microwave Res. Inst. Programs Nov. 1967 p 83-86 refs (See N68-16927 07-10)
(Contract N00014-67-A-0438-0001)

A generalized Hamiltonian is formed and used in the quantum mechanical treatment of a multimode laser amplifier. This simplified model contains the electromagnetic field energy, the quantum energy identical to a two energy level pumping system, and the interaction between the radiation field and the molecules. The exciting and de-exciting operators of the pumping molecule obey the usual fermion anti-commutation rules. Heisenberg equations of motion are used to form the coupled differential equations of motion for the operators and it is shown that the amplification process leads to increasing correlation between modes. The solution proceeds via the Laplace transformation of the equation of motion and the obtained results show that the model builds up electromagnetic field energy whenever a large initial potential population inversion exists. G.G.

N68-17082# Naval Research Lab., Washington, D. C. Electron Tubes Branch.
HELIUM-NEON LASER DISCHARGE PARAMETER STUDY
Wayne T. Whitney (M.S. Thesis—Maryland Univ.) 21 Jun. 1967 48 p refs
(NRL-6536; AD-655437) CFSTI: HC $3.00/MF $0.65

An experimental study was made to determine which energy level is dominant in limiting the output power of the helium-neon laser. This was done by comparing laser power versus discharge current data for the three main laser transitions, with the temperature and pressure as parameters. Relative saturation behavior indicates that at low pressures the upper level population rate controls the output power of all three laser lines; and at high pressures (above 1 torr) the lower level depopulation rate is more important for the 0.63 and 1.15 microns lasers. The optimum pressure for maximum output of the 0.6328 micron laser occurs at an intermediate pressure (0.7 torr) where both effects are important. All of the data were taken on the same tube, (8 mm. i.d.), utilizing ultra high vacuum techniques to maintain gas purity. It was found that an increase in the laser tube wall temperature will produce an increase in laser power at high pressures (as much as 500% for 1.15 microns); but will decrease the power at low pressures. Also of interest in the data is the fact that the 1.15 micron line can be made to oscillate at total pressures at least as high as 20 torr. Author (TAB)

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N68-16128# Columbia Univ., New York. School of Engineering and Applied Science.
VACANCY ANNEALING IN IRRADIATED TUNGSTEN Final Progress Report, Part 2
Dexter A. Jeannotte 1967 56 p refs
(Contract AT(30-1)-3551)
(CU-3551-8) CFSTI: HC $3.00/MF $0.65

Vacancy removal in irradiated tungsten has been studied by direct observation with a field ion microscope. This direct observation of the vacancy fraction has established the following: Vacancy migration is responsible for the decay in resistivity of irradiated tungsten near 900°C. In this temperature region vacancies migrate with an activation energy of approximately 3.3 eV, following first order kinetics. The number of jumps to annihilation for a migrating vancancy is indicated to be approximately 10^4. The sink density in irradiated materials is likely to be a function of radiation dose with approximately 10^{-8} sinks per fast neutron for doses less than saturation. Correlation of present results with previous work indicates that Stage III recovery in body centered cubic materials is probably due to an impurity-dislocation reaction. Author (NSA)

N68-16136# Rensselaer Polytechnic Inst., Troy, N. Y.
STUDY OF THE EFFECT OF HYDROSTATIC PRESSURE ON SELF-DIFFUSION RATES IN HEXAGONAL METALS Progress Report
H. Michael Gilder Oct. 1967 6 p refs
(Contract AT(30-1)-3820)
(RPI-3820-1) CFSTI: HC $3.00/MF $0.65

Equipment was designed, constructed or acquired for measurement of the effect of hydrostatic pressure on self diffusion rates in hexagonal metals. Author (NSA)

N68-16169# California Univ., Berkeley. Lawrence Radiation Lab.
EFFECT OF A STRAIN INDUCED TRANSFORMATION ON THE TOUGHNESS OF HIGH STRENGTH MATERIALS
Christian Pierre Laporte (M.S. Thesis) Sep. 1967 50 p refs
(Contract W-7405-ENG-48)
(UCRL-17810)

The fracture toughness of steels which exhibit a good combination of strength and ductility is examined. The principal variables investigated by fracture testing single-edge-notched specimens were the amount of C in the steels and the temperature of previous deformation. The toughness was found most sensitive to rolling temperature at low testing temperatures, but keeps a constant value in the vicinity of M_D. Rolling performed at 450°C depressed the temperature M_D and, thus, the amount of martensite induced during straining. For this temperature the toughness has been found very low, especially for the lowest C-content alloy. Good values of toughness (100 to 130 ksi $\sqrt{in}$) found for alloys whose strength was varying from 130 ksi to 200 ksi should still accompany higher strength levels (250 ksi) with a steady ductility (25%). Author (NSA)

N68-16173# Charles River Associates, Inc., Cambridge, Mass.
ECONOMIC ANALYSIS OF THE PLATINUM GROUP METALS
Jun. 1967 170 p refs
(Contract GS-OOP-23194(SCM))
(PB-176155) CFSTI: HC $3.00/MF $0.65

The study focuses on platinum and palladium as they are far the most abundant and important metals of the group and very little is known about the four minor metals: iridium, rhodium, osmium and ruthenium. Palladium consumption has grown rapidly over the past fifteen years and now substantially exceeds platinum consumption. Platinum consumption has increased in the past three years; however, it has been relatively static over the 1955-1965 period. The platinum metals are used primarily as catalysts in the petroleum and chemical industry and as part of the make-up of consumer and producer durables by the communications, electric and electronic equipment and aerospace industries. As a petroleum refining catalyst, the platinum metals are capital stocks subject to virtually no loss through use. There is a small loss of the platinum

metals used by the chemical industry in catalytic applications. The demand pattern for the platinum metals differs according to whether the use is for catalytic or non-catalytic applications.
Author

N68-16267*# IIT Research Inst., Chicago, Ill.
METAL CARBIDE–GRAPHITE COMPOSITES
25 Jan. 1968 35 p refs
(Contract NASr-65(09))
(NASA-CR-92723; IITRI-G6005-06) CFSTI: HC $3.00/MF $0.65
CSCL 11D

Examination of the high temperature behavior of NbC-C composites fabricated using different carbon sources has revealed significant differences not indicated in room temperature studies. These studies have shown that properties are greatly influenced by choice of materials. The following findings are considered the most significant for this period: (1) At a carbide content of 46.5 vol%, composites incorporating Sterling 10R (S10R) carbon black show the best high temperature behavior. Their resistance to flexural deformation, particularly in the A/G direction was superior to that for any of the composites tested. The S10R composite also exhibits low anisotropy in its properties. Of particular significance, is the thermal expansion behavior for which the A/G to W/G ratio is 1.13. (2) The composites incorporating Varcum (resin coke), M-2 (synthetic graphite) and CPC (calcined petroleum coke) also displayed good high temperature properties. Studies of these materials will take a secondary role to examination of S10R.
Author

N68-16282# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PHASE DIAGRAMS OF SYSTEMS OF HYDROGEN WITH TITANIUM, ZIRCONIUM, VANADIUM AND NIOBIUM [FAYOVYYE DIAGRAMMY SISTEM VODORODA S TITANOM, TSIRKONIYEM, VANADIYEM I NIOBIYEM]
G. V. Samsonov and M. M. Antonova 17 Jul. 1967 14 p refs
Transl. into ENGLISH from Ukr. Khim. Zh. (Kiev), v. 32, no. 6, 1966 p 555–559
(FTD-HT-23-925-67; AD-663333)

Phases of the systems titanium-hydrogen, zirconium-hydrogen, vanadium-hydrogen, and niobium-hydrogen with compositions ranging from no hydrogen to TiH1.93, ZrH2, VH0.915 and NbH at room temperature were studied by x-ray diffraction. The lower boundaries of the region of homogeneity of the beta-phase are shifted in a regular manner toward a lower hydrogen content on passing from titanium to niobium; this corresponds to the increase in the filling of the d-subshell of the corresponding transition metals. A satisfactory agreement between x-ray and pycnometric density values was found for the Zr-H and Nb-H systems; the discrepancy of these values in the Ti-H system is attributed to the fact that the hydrides studied were not in a state of equilibrium.
TAB

N68-16309# British Non-Ferrous Metals Research Association, London (England).
THE CREEP PROPERTIES OF MOLYBDENUM AT 650–750°C Final Report
J. E. Bowers, R. D. S. Lushey, and P. W. J. Sansom Culcheth, Engl. Reactor Group, United Kingdom Atomic Energy Authority Jan. 1967 16 p ref
(Contract CON/TRG/160888)
(BNFMRA/RR/A1625; TRG-1550(C/X)) CFSTI: HC $3.00/MF $0.65

Pure molybdenum sheets, 0.04 in. thick, prepared from both arc cast ingot and sintered slab were creep tested at 650 and 750°C. For each material tests were done on both recrystallized strip and samples given a stress-relieving (recovery) anneal. Sheet made from sintered stock had a better creep resistance than that made from arc melted material.
Author (NSA)

N68-16315# Columbia Univ., New York. Henry Krumb School of Mines.
RADIATION DAMAGE IN PLATINUM, PART 1 Final Progress Report
Michael Attardo (Ph.D. Thesis) Feb. 1967 120 p refs
(Contract AT(30-1)-3551)
(CU-3551-7) CFSTI: HC $3.00/MF $0.65

Defects introduced into 99.9998% pure platinum by fast neutron irradiation have been studied by field-ion microscopy and tensile testing. A large variety of defects have been observed in the irradiated crystals. Damaged or depleted zones have been identified and their concentration and size has been studied as a function of annealing temperature. The observed density and size distribution of these defects agrees with the neutron energies and total exposures used. In the irradiated crystals, the yield stress recovers in two distinct recovery stages, occurring at 200 to 300°C and 500 to 600°C. The first stage exhibits an activation energy of 1.5±.2 eV. The recovery stages are associated with the removal of single vacancies and the removal of depleted zones as followed by field ion microscope observations. Stage III recovery in platinum has also been studied by examining specimens irradiated at temperatures above and below stage III recovery. Direct observation indicates that some form of interstitial atom motion must be associated with this recovery stage since the configuration of the interstitial atom resembles that of the split or dumbbell interstitial configuration. Investigation of the interstitial atoms formed at 4.2°K reveals a different form of interstitial configuration. The observations give direct confirmation of the two interstitial model of radiation damages in face-centered cubic metals. Measurements of the single vacancy concentration on the |102| plane in well-annealed platinum, as revealed by field ion microscopy, are abnormally high (from 1 to 20×10^{-3}). An investigation indicates that such vacancies are introduced by the field evaporation process. This observation precluded the study of individual lattice vacancies, as introduced by irradiation, with the field ion microscope.
Author (NSA)

N68-16319# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
MATERIALS CHARACTERIZATION STUDY. ULTRASONIC LONGITUDINAL AND SHEAR VELOCITIES OF CANDIDATE ISOTOPE ENCAPSULATION MATERIALS
William D. Jolly Oct. 1967 14 p refs
(Contract AT(45-1)-1830)
(BNWL-547) CFSTI: HC $3.00/MF $0.65

Ultrasonic longitudinal and shear velocities were measured for Inconel X, Hastelloy X, Hastelloy C, TZM, 304L, 416, L605, Haynes 25, tungsten, tantalum, and molybdenum, which are candidate cladding materials for isotope heat capsules. The specimens used for this program were random samples of several configurations which required the use of different methods for velocity measurements. The differential path method was employed when possible because of its inherent accuracy. The pulse echo method and the through transmission method were required for some specimens, while for others the plate resonance method was used. Methods used for the velocity measurements are described briefly. Included is a table listing the composition of materials and the method of velocity measurement for each specimen. A table of velocity data for the materials considered is provided which lists velocity in cm/sec and in./sec, and calculated values of acoustic impedance in g/cm^2-sec.
Author (NSA)

N68-16329# National Lead Co. of Ohio, Cincinnati.
SUMMARY TECHNICAL REPORT, 1 JANUARY–31 MARCH 1967
R. Burgett, ed. Apr. 1967 30 p refs
(Contract AT(30-1)-1156)
(NLCO-996) CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. THE ALPHA SPECTROMETRIC DETERMINATION OF NEPTUNIUM AND PLUTONIUM IN URANIUM PROCESS SOLUTIONS H. W. Humphrey, B. L. Twitty, and K. M. Fritz 8 p refs (See N68-16330 07-06)

2. ELEVATED-TEMPERATURE DROP-HAMMER TESTS OF CAST URANIUM-BASE DILUTE BINARY ALLOYS L. G. Wexlin and R. E. Du Vall 6 p refs (See N68-16331 07-17)

3. SURFACE DEFECTS IN ROLLED URANIUM RODS H. W. Hesselbrock 13 p refs (See N68-16332 07-17)

N68-16331# National Lead Co. of Ohio, Cincinnati.
ELEVATED-TEMPERATURE DROP-HAMMER TESTS OF CAST URANIUM-BASE DILUTE BINARY ALLOYS
L. G. Wexlin and R. E. Du Vall *In its* Sum. Tech. Rept., 1 Jan.–31 Mar. 1967 Apr. 1967 6 p refs (See N68-16329 07-17)

Cast binary uranium alloys containing as much as 1000 ppm of carbon, iron, silicon, or aluminum were tested with a drop hammer at temperatures ranging from 885 to 1200°F. Author

N68-16332# National Lead Co. of Ohio, Cincinnati.
SURFACE DEFECTS IN ROLLED URANIUM RODS
H. W. Hesselbrock *In its* Sum. Tech. Rept., 1 Jan.–31 Mar. 1967 Apr. 1967 13 p refs (See N68-16329 07-17)

A study was made of the source, nature, and development of surface defects in rolled uranium rods. The study revealed areas where further work should lead to the reduction of OD machining stock in producing uranium fuel cores. Author

N68-16421# Washington Univ., Seattle. Coll. of Engineering.
PHASE TRANSFORMATIONS IN A EUTECTOID BINARY ALLOY SYSTEM Progress Report
15 Oct. 1967 52 p refs
(Contract AT(45-1)-1375)
(RLO-1375-5; PR-8) CFSTI: HC $3.00/MF $0.65

A study has been made of the effects of alloy constitution on the electrical properties of Ti–Cr binary alloys. The utilization of electrical resistance measurements to explore the beta to omega reaction constitutes a major portion of this work. The problem of developing an explanation for the observed negative value of $d\rho/dT$ has received special attention. Measurements have been conducted on alloys containing up to 12 atom percent Cr in both the asquenched and the quenched and aged conditions. The negative value of $d\rho/dT$ in Ti–Cr alloys has been identified solely with the retained beta phase and appears to be independent of the omega reaction. A model based on the concept of a relative shift in the s and d bands in alloyed titanium has been developed to explain the anomalous negative temperature coefficient of resistivity. The fine structure of the HCP martensite in Ti and alloys containing 2.4 to 5.9 at. % Cr has been investigated, and the results have been interpreted. The habit plane, orientation relations, and lattice correspondence for the acicular martensite formed in Ti–Cr alloys has been found to remain independent of Cr content. The crystallographic theory does not predict this twin mode for lattice invariant deformation, and it has been attributed to accommodation occurring within a martensite plate during transformation. The spontaneous transformation of the metastable beta phase in Ti–Cr alloys during thinning has also received further study. NSA

N68-16596# Bureau of Mines, Rolla, Mo.
EVALUATION OF ROLLING SLABS OF ZINC–COPPER–TITANIUM ALLOYS CAST UNDER SEMICONTINUOUS CONDITIONS
L. A. Neumeier, J. T. Dunham, and P. G. Barnard Mar. 1968 26 p refs
(BM-RI-7089)

Sound experimental ingots of zinc alloys for use as rolling slabs were cast with a specially constructed, semicontinuous casting machine. Nominal alloy compositions of Zn-1.0% Cu, Zn-0.12 and 0.36% Ti, and Zn-1.0% Cu-0.03 to 0.36% Ti were cast. This study was conducted to evaluate the suitability of the casting procedure for providing stock for rolling into sheet. Microscopic examination of ingot sections revealed structures in which grain size varied from the outer to center ingot zones. Chemical analysis revealed that compositional segregation is not a significant factor in the formation of the ingot structure. Microstructural studies of small ingots of similar alloys solidified at slow, fast, and intermediate rates confirmed that the ingot structure in the semicontinuous-cast ingots is related to cooling rate. Microstructures of thin sheet hot-rolled from slabs of the semicontinuous-cast ingots were found to be uniform. Results of hardness surveys demonstrated that copper and titanium enhance hardness. Author

N68-16649# Oak Ridge National Lab., Tenn.
RADIATION METALLURGY SECTION, SOLID STATE DIVISION Progress Report, for Period Ending Jul. 1967
D. S. Billington and M. S. Wechsler Nov. 1967 63 p refs
(Contract W-7405-ENG-26)
(ORNL-4195; UC-25) CFSTI: HC $3.00/MF $0.65

The radiation embrittlement of weld heat-affected-zone (HAZ) samples and base-plate samples of ASTM A-212B pressure vessel steel is being investigated as a function of radiation dose and temperature. The increase in ductile–brittle transition temperature is sharply reduced for irradiation temperatures above 300°C. Tensile tests, electrical resistivity measurements, and internal friction measurements were conducted on unirradiated and irradiated vacuum-melted Fe with and without the addition of 20 wt ppM of N. Defect clusters and dislocation channeling were observed in neutron-irradiated Nb for the first time. The post-irradiation annealing stage in Nb at 150°C was shown to be due to the motion of O to radiation-produced defects. Temperature dependence of the yield stress in single-crystal Nb was virtually unchanged by neutron irradiation, in agreement with previous results from Fe indicating that the mechanism for the thermal activation of flow is not affected by the radiation-produced defects. The stress dependence of dislocation velocity was measured directly by etching techniques for unirradiated Nb as a function of temperature and number of zone passes and for irradiated single-zone-pass Nb at room temperature. Author (NSA)

N68-16660# European Atomic Energy Community, Ispra (Italy).
Al–Al_2O_3 COMPOUNDS CHARACTERIZED BY AMORPHOUS-PHASE OXIDE [COMPOSITES Al–Al_2O_3 CARACTERISES PAR L'OXYDE EN PHASE AMORPHE]
G. Beghi and M. Nasi Brussels Dec. 1967 32 p refs In ITALIAN; ENGLISH summary
(EUR-3660.f)

The possibility of maintaining aluminium oxide of extruded Al–Al_2O_3 alloy in the amorphous phase, as in the starting powders, has been verified. Fabrication cycle is analogous to SAP, but temperature and time of sintering, compaction and extrusion are reduced; temperatures are not exceeding 450°C. In order to evaluate the influence of the different factors, two other materials have been prepared: SAP extruded at a lower temperature (450°C) and Al–Al_2O_3 alloy with aluminium oxide crystallized after extrusion. Mechanical properties (tensile tests) of the Al-amorphous Al_2O_3 alloy have a tendency to reduce ductility; but the comparison with the other above mentioned materials has shown that this is principally the effect of lower temperature extrusion. Author

N68-16667*# Case Inst. of Tech., Cleveland, Ohio.
EFFECT OF ULTRASONIC VIBRATION ON PRECIPITATION HARDENING OF STEELS AND SUPERALLOYS
Stanley G. Young (M.S. Thesis) Jun. 1968 126 p refs Sponsored by NASA
(NASA-CR-92801) CFSTI: HC $3.00/MF $0.65 CSCL 11F

The effects of ultrasonic vibration on the precipitation hardening of Vasco 300 maraging steel, 17-4 PH steel, A-286, René 41, and L-605, were studied. Specimens were subjected to peak-to-peak

vibration amplitudes from 0.8 to 6.4 mils at a frequency of 25,000 hertz while they were undergoing standard aging heat treatments. The application of ultrasonic vibration was found to increase the hardening rate, but the increase was less than that reported by previous investigators. Local heating of the vibrating specimen and differences in the heat treating environments were found to be the most likely causes of the wide differences between the results of various investigators. Stress level did not affect the amount of precipitate or the rate of age hardening. The yield and tensile strengths of vibrated specimens of Vasco 300 maraging steel increased by approximately 2 to 3 percent above the static aged condition providing overaging did not occur. Author

N68-16684# Canada. Dept. of Mines and Tech. Surveys, Ottawa. Mines Branch.
COPPER ZIRCONIUM ALLOYS (A LITERATURE SURVEY)
J. L. Dion and R. Thomson Nov. 1966 24 p refs *Its* Inform. Circ. IC 186
(NP-17123) Available from Atomic Energy of Canada, Ltd., Chalk River: $0.75

A review of work on high-conductivity Cu–Zr alloys is presented, covering such topics as the phase diagram, melting procedures, fabrication, heat treatment, properties and applications. Comparative reference is made to other high-conductivity alloys. The further development of Cu–Zr alloys includes the addition of third elements such as Cr, As, and Hf. Author (NSA)

N68-16715# Iowa State Univ. of Science and Technology, Ames.
SESSILE DROP TEST TO STUDY WETTING BY LIQUID METALS IN METALLIC SYSTEMS
Robert Craig Maze (M.S. Thesis) Nov. 1967 60 p refs
(Contract W-7405-ENG-82)
(IS-T-205) CFSTI: HC $3.00/MF $0.65

The wetting of 316 stainless steel by lead-bismuth eutectic was determined using a sessile drop test at 140 to 620°C and at 10^{-8} to 10^{-7} torr. The procedure uses a non-linear regression technique combined with the differential equations used to describe the sessile drop. Initial estimates of the drop shape parameter β and the radius of curvature at the drop apex (b) must be made to start the computation. A computer program to perform the calculations has been written and is explained. Studies carried out at constant temperature show that drop surface tension increases, contact angle decreases, and spreading coefficient increases with time when the temperature is held constant at temperatures above 400°C. Chemical analysis of the drop shows that chromium, nickel, iron, and manganese concentrations within the drop all increase with temperature. It was found that microprobe analysis of the interface of a frozen drop-to-316 stainless steel cross section would show the extent to which the drop penetrates the 316 and in addition would give an estimate of the concentration profile of a given element across the drop-stainless steel interface. Results of this study were obtained using relatively inaccurate drop coordinate measuring equipment. NSA

N68-16738# Battelle Memorial Inst., Columbus, Ohio. Defense Metals Information Center.
BERYLLIUM: DMIC REVIEW OF RECENT DEVELOPMENTS
H. D. Hanes and F. T. Zurey 2 Jun. 1967 5 p refs
(NP-17108)

A review of recent developments (Jan. 1966 to Jan. 1967) in the metallurgy of Be is presented. Data are given on machinability, joining, physical metallurgy, recommended machining processes including tool geometry, and corrosion protection. Significant data on Be–Al alloys and Be–Cu alloys are tabulated as are physical properties of brazing alloys. NSA

N68-16786# Bureau of Mines, Bruceton, Pa.
EFFECTS OF ADDING RARE-EARTH SILICIDES, ALUMINUM, AND CRYOLITE TO MOLTEN STEEL
R. J. Leary, R. T. Coulehan, H. A. Tucker, and W. G. Wilson (Molybdenum Corp. of Am., New York) Mar. 1968 44 p refs
(BM-RI-7091)

The effects of various rare-earth metal addition practices on the macrostructure and pattern of sulfur distribution in steel ingots were investigated. Heats of plain carbon steel were melted in a 1-ton, basic electric-arc furnace. Melts were treated with mixtures of rare-earth silicides, aluminum, and cryolite either in the furnace before tap or in the ladle after tap to determine the effects of this form of rare-earth treatment upon ingot macrostructure. Results showed that furnace deoxidation was controlled by the concentration ratio of rare earths:aluminum. During casting, deoxidation was controlled by the concentration of rare earths. Oxygen contents equivalent to vacuum ladle degassing resulted from air-melt furnace treatments with the rare-earth mixtures described. Rare earths in steel inhibited the onset of equiaxed grain formation during ingot freezing, and also virtually prevented interdendritic segregation of sulfides. Author

N68-16876*# Battelle Memorial Inst., Columbus, Ohio. Radiation Effects Information Center.
THE EFFECTS OF NEUTRON RADIATION ON STRUCTURAL MATERIALS
M. Kangilaski 30 Jun. 1967 245 p refs
(Contract NASw-1568)
(NASA-CR-93128; REIC-45) CFSTI: HC $3.00/MF $0.65 CSCL 18J

A compilation of the data available on the effects of radiation on tensile, creep, fatigue, impact, and hardness properties of various structural materials is presented. These properties are given as a function of test temperature, irradiation temperature, and radiation fluence. Specifically the following reactor materials are covered: (1) aluminum alloys, (2) magnesium alloys, (3) beryllium, (4) zirconium alloys, (5) mild steels, (6) stainless steels, (7) nickel alloys, and (8) refractory metals. Data on the effects of radiation on the mechanical properties of selected materials at cryogenic temperatures also are included. Author

N68-16892# Maryland Univ., College Park.
AN INVESTIGATION OF IRRADIATION STRENGTHENING OF B.C.C. METALS AND SOLID SOLUTIONS Progress Report, Jan.–Oct. 1967
R. J. Arsenault Nov. 1967 4 p refs
(Contract AT(40-1)-3612)
(ORO-3612-4) CFSTI: HC $3.00/MF $0.65

Impure polycrystalline V samples irradiated at 2.8×10^{19} and 2×10^{20} nvt in the CP-5 reactor were investigated. Results were similar. No change in the rate controlling mechanism of slip was found. Samples of the lower dose rate were tested in tension but those in the higher dose rate were tested in compression in a specially designed rig. High purity single crystals have been irradiated and will be investigated when they are less radioactive. NSA

N68-17004# Centre National de Recherches Metallurgiques, Liege (Belgium).
STUDY OF EMBRITTLEMENT BY PLASTIC FATIGUE OF STEELS FOR REACTOR VESSELS, VOLUME 2 Final Report
R. V. Salkin and P. E. Lagasse 15 Jul. 1967 128 p refs
(Contract EURATOM-005-63-12-TEEB)
(EURAEC-1892: FR-1)

Embrittlement of steel induced by alternate plastic deflections and the influence which periods of maintenance at maximum deformation have on plastic fatigue stresses were studied for three construction steels with high limits of elasticity. Symmetrical tensile compression with imposed deformation and biaxial alternate bending were applied. Fatigue bending tests and damage by plastic fatigue tests were performed at 20 and 300°C. NSA

N68-17005# Centre National de la Recherche Scientifique, Paris (France).
[ON CORROSION OF STAINLESS STEEL] Quarterly Report, 1 Jan.–31 Mar. 1967
G. Chaudron 31 Mar. 1967 21 p
(Contract EURATOM-059-65-1-TEEF(RD))
(EURAEC-1918; EUR-3400) CFSTI: HC $3.00/MF $0.65

The influence of very small quantities of carbon on the corrosion by superheated steam is studied. Results indicate that the alloys with the lowest carbon content (20 to 30 · 10^{-6}) are sensitive to intergranular penetration of the oxide. The influence of platinum additions in stainless steels on the resistance to corrosion by superheated steam is studied. The presence of platinum reduces the absolute value of the corrosion rate, but at 600°C this may cause a slight sensitivity to intergranular corrosion. Stress corrosion results for boiling magnesium chloride shows that this corrosion is associated with the formation of a passive film. Potentiokinetic curves plotted in magnesium chloride at 154°C show the great capacity of stainless steel for passivating in such a medium (18/10 and 20/25 steels, Ni 80%–Cr 20% alloy). The formation of a passivation film on stainless steel samples immersed in boiling magnesium chloride was also established by using electron diffraction.
NSA

N68-17006# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.
DIFFUSION IN THE PLUTONIUM ZIRCONIUM SYSTEM [DIFFUSION DANS LE SYSTEME PLUTONIUM ZIRCONIUM]
Jean-Claude Lauthier (Ph.D. Thesis—Paris Univ., Orsay (France)) Jul. 1967 80 p refs In FRENCH
(CEA-R-3275)

Intermetallic $PuZr_2$ cannot be obtained by a direct synthesis. The formation is probably due to oxygen enhancement of diffusion processes by a contribution of bound extrinsic vacancies. Results of investigation of a range of alloys from 15 to 50 at.% Pu pointed out the nature of the isothermal transformation. It takes place at 615±5°C and is of the peritectoid type: Pu ϵ (bcc) + $Zr\alpha$ (hex) $\rightleftarrows$ Pu δ (fcc). Diffusion coefficients have been determined from couples made of PuZr dilute alloys (1.15 and 0.115 at.% Pu) and pure zirconium; these couples have been annealed at 700 to 840°C from 1000 to 3000 hours. The curves C = f(x) were plotted by X-ray microanalysis and α autoradiography. They have been analyzed assuming that the diffusion coefficient was constant. Results are: DZrPU (1.15% = 11.1 e–65,000/RT. DZrPU (0.115%) 0.1 e–54,000/RT.
Author (NSA)

N68-17089*# Solar, San Diego, Calif.
STRUCTURAL AND MECHANICAL EFFECTS OF INTERSTITIAL SINKS
Mark J. Klein Jan. 1968 30 p refs
(Contract NAS7-469)
(NASA-CR-92674; RDR-1534-6) CFSTI: HC $3.00/MF $0.65
CSCL 11F

The effects of a titanium interstitial sink on the interstitial concentration and the recrystallization of TZM and T222 were studied in the temperature range 2000°F to 2700°F. The grain structure of these alloys was not significantly affected by the action of the titanium sink. The carbon concentration of the TZM, however, was reduced to less than one-half of its initial concentration when this alloy was vacuum annealed with or without titanium. The carbon concentration of the T222 was not reduced by the same annealing treatments. The activation energy for creep of D43 was determined from 1600°F to 3200°F. Above about 2200°F the activation energy for creep is equal to that for self-diffusion and is independent of stress and temperature. Below about 2200°F preliminary results indicate that the activation energy for creep is greater than that for self-diffusion.
Author

N68-17146# Royal Aircraft Establishment, Farnborough (England).
CONCERNING THE QUESTION OF METHODS OF REDUCING THE GRAIN SIZE OF CAST ALLOY STEEL BY THERMAL TREATMENT [K VOPROSU O SPOSOBAKH IZMEL'CHENIYA ZERNA LEGIROVANNOI LITOI STALI TERMICHESKOI OBRABOTKOI]
V. D. Sadovskii, K. A. Malyshev, and B. G. Sazonov Oct. 1967 26 p refs Transl. into ENGLISH from Akad. Nauk SSSR (Moscow), no. 17, 1956 p 3–19
(RAE-LIB-TRANS-1256)

Support is added to the proposal that complete recrystallization of alloy steel takes place on heating, only when a critical temperature, which is in excess of the Ac_3 point, is exceeded. On heating to a temperature between the critical point and the Ac_3 point, the austenite retains an orientation dependence on the original structure. This dependence inhibits the refinement of the as-cast coarse grained structure of a casting. A double heating sequence is proposed for the refinement of such a structure, consisting of a high temperature heating to achieve complete recrystallization followed by a lower temperature treatment, just above the Ac_3 point, to achieve a smaller grain size.
Author

N68-17181# Pittsburgh Univ., Pa. Dept. of Physics.
A STUDY OF RADIATION INDUCED DEFECTS IN METALS Progress Report, 6 Nov. 1966–3 Nov. 1967
John R. Townsend 3 Nov. 1967 27 p refs
(Contract AT(30-1)-3653)
(NYO-3653-2) CFSTI: HC $3.00/MF $0.65

Progress in low temperature irradiations of Cu and W and in computer simulations of defect metal lattices is reported. Both Cu and W show very low temperature anelastic processes which are stable at the temperatures of observation. In the case of Cu, a peak in internal friction occurs near 12° for vibrational frequencies near 1 kHz, appears to rise from a point defect produced by irradiation in a pure Cu lattice, has a neutral stress axis parallel to the ⟨100⟩ direction, corresponds with thermal activation energy of about 0.02 eV, and disappears in the temperature range associated with annealing stages I-D and I-E in electrical resistivity experiments. A corresponding W anelastic process has not been studied in such detail; it is found near 13 to 14°K at a frequency of 1 kHz, is stable until annealing near 25°K, and is apparently due to an irradiation produced defect in the pure W lattice. Elastic bulk effects in Cu and W are negative even when irradiation occurs at 15 to 20°K and measurements are made at liquid He temperature. This result is now believed to be due to anelastic processes active enven at 4.2°K. Computer programs are available for simulating atomic lattices by using two body interaction potentials and long range cohesive forces. The lattice can be imbedded in an infinite blanket of elastic continuum, or it can have a blanket of finite thickness. The latter case is useful in investigating the effect of the defects on the elastic constants. As an example of this type of calculation, it has been found that one atomic percent of vacancies in tungsten would raise the bulk modulus by 1.9 per cent demonstrating the importance of image force terms in elastic bulk calculations. Progress on piezo-resistance measurements has been slight. The mechanical drive has been replaced by an electromagnet drive and circuit fluctuations reduced sufficiently to reach the goal of 1 microvolt sensitivity. Carbon and nitrogen doped Fe wires are on hand to test the apparatus.
Author (NSA)

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N68-16111*# General Electric Co., Philadelphia, Pa. Missile and Space Div.

SOME FUNDAMENTAL FRACTURE MECHANISMS APPLICABLE TO ADVANCED FILAMENT REINFORCED COMPOSITES

J. Mullin, J. M. Berry, and A. Gatti Sep. 1967 37 p refs *Its* Tech. Inform. Ser.

(Contracts NASw-1383; NASw-1543)

(NASA-CR-92721; R67S051) CFSTI: HC $3.00/MF $0.65 CSCL 11D

The critical fracture modes of an epoxy matrix in the vicinity of a break in a high modulus, high strength filament were established experimentally. Three distinct failure modes were observed to occur and the nature of these three modes is explained through an analysis of the stress state in the matrix. A single filament embedded in an epoxy novolac was used to examine the fracture process. The advantage of using this type of resin arises from its ability to be modified to varying degrees of crack sensitivity. The effects of varying gross strain rate were evaluated and the study was then extended to specimen configurations containing more than one filament. This approach permits the examination of the interaction of nearby filaments with localized fracture processes. Filaments of boron on tungsten (B/W), boron on silica (B/SiO_2), boron carbide on B/W and tungsten wire were used with epoxy novolac. Author

N68-16124*# IIT Research Inst., Chicago, Ill. Technology Center.

DEVELOPMENT OF SPACE STABLE THERMAL CONTROL COATINGS Triannual Report, Mar. 1–Jul. 31, 1967

G. A. Zerlaut, G. Noble, and F. O. Rogers 22 Sep. 1967 77 p refs

(Contract NAS8-5379)

(NASA-CR-61502; IITRI-U6002-55) CFSTI: HC $3.00/MF $0.65 CSCL 11C

Continued research in the development of thermal-control surface coatings centered on (1) synthesis, stability to ultraviolet irradiation, and solid state behavior of zinc titanates; (2) effect of pregrinding the silicate-treated ZnO prior to manufacture; and (3) design, construction, and initial checkout tests on an evacuated, dual-beam irradiation chamber for ultraviolet spectroscopic measurements in situ. Experimental procedures are given for synthesis of three zinc titanates, along with a table showing the visible and ultraviolet spectra of each. Graphical presentation of data from space simulation tests is given to illustrate stability variations in samples after ultraviolet radiation in a vacuum. Solid state chemistry of zinc titanates is discussed in relation to five areas: pigment in a space coating, anistropy, impurities and crystalline perfection, surfaces states, radiation effects, and interaction of surface and bulk properties. B.S.D.

N68-16438*# Peninsular ChemResearch, Inc., Gainesville, Fla.

DEVELOPMENT OF VULCANIZABLE ELASTOMERS SUITABLE FOR USE IN CONTACT WITH LIQUID OXYGEN Annual Summary Report, 9 May 1966–8 May 1967

Paul D. Schuman 8 May 1967 83 p refs

(Contract NAS8-5352)

(NASA-CR-61530; ASR-4) CFSTI: HC $3.00/MF $0.65 CSCL 11J

In attempts to copolymerize trifluoroacetaldehyde with perfluoropropylene epoxide, a new reaction was found which yields previously unknown esters having the structure $R_fCOOCHFCF_3$. Polymer composition curves for the fluorocarbon vinyl ethers with vinylidene fluoride have been prepared. Attempts to prepare a polyester using trifluoroacetaldehyde hydrate as the diol have not been successful. Some preliminary experiments have been run to determine the feasibility of preparing a poly(thioperoxide). Attempts to exhaustively dechlorinate $CF_3OCCl_2CFCl_2$ did not yield $CF_2OC = CF$. Reaction of $CF_3OCFClCFClOCF_3$ with zinc results in decomposition. Some preliminary experiments have been run to determine the feasibility of preparing a fluorocarbon polyperoxide. An elastomeric copolymer of $C_3F_7O(CF(CF_3)CF_2O)_2CF = CF_2/CF_2 = CH_2$ has been prepared. A $CF_3OCF = CF_2/CF_2 = CH_2$ copolymer containing 83.8 mole percent $CF_2 = CH_2$ was found to be LOX compatible. Tensile strength and elongation of $R_fOCF = CF_2/CF_2 = CH_2$ above and below T_g suggest usable mechanical properties below T_g. Preliminary attempts have been made to plasticize and determine the effect of plasticization on physical properties of a $CF_3OCF = CF_2/C_2F_4$ copolymer. The fluorocarbon diketone, $(CF_3)_2CFCO(CF_2)_3COCF(CF_3)_2$, has been prepared. Author

N68-16474*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

EFFECT OF GAMMA RADIATION IN VACUUM ON THE TENSILE PROPERTIES OF POLYMER FILMS

Howard L. Price [1967] 26 p refs Presented at the ASME Winter Ann. Meeting, Pittsburgh, 12–16 Nov. 1967

(NASA-TM-X-60858) CFSTI: HC $3.00/MF $0.65 CSCL 11I

The tensile properties of polymer films have been measured in air after the films were exposed to gamma radiation in vacuum. The dose rate was approximately 1.6 megarads per hour for doses to 2,000 megarads at a pressure of 10^{-6} torr. Four 0.001-inch-thick films were tested: poly(ethylene terephthalate) or PETP; poly(cyclohexylenedimethylene terephthalate) or PCTP; poly(vinylidene fluoride) or PVF_2; and a polyimide or PI. The yield strength, tangent modulus, tensile strength, and elongation at break were obtained from the tensile tests. The average value and standard deviation of each property are given, based on the results of twenty-five tests at each dose. The data show the effect on the tensile properties of chain scission and cross linking, and indicate the useful dose range of the films subjected to ionizing radiation. Author

N68-16484*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

STRESS DEPENDENCE OF TENSILE CREEP RATE IN CARBONS AND GRAPHITES

D. B. Fishbach 1 Jan. 1968 7 p refs

(Contract NAS7-100)

(NASA-CR-92706; JPL-TR-32-1238) CFSTI: HC $3.00/MF $0.65 CSCL 11B

With the use of an empirical relationship, values for the stress exponent were obtained for a pyrolytic carbon and for two grades of glassy carbon. It appears that during the initial deformation in pyrolytic carbon, dislocation climb may be important; however, for elongation greater than 1%, a viscous process such as Nabarro–Herring creep becomes predominant. For glassy carbon, the stess exponent was found to increase approximately linearly with stress. Thus, Nabarro–Herring creep may be significant in this material at low stresses, but some other mechanisms, as yet unknown, must operate at medium and high stresses. Author

N68-16526*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

A NEW DEFORMATION MECHANISM IN PYROLYTIC CARBON AT HIGH TEMPERATURES

G. M. Jenkins 15 Feb. 1968 19 p refs

(Contract NAS7-100)

(NASA-CR-92748; JPL-TR-32-1243) CFSTI: HC $3.00/MF $0.65 CSCL 11B

It is demonstrated that the creep deformation of pyrolytic graphite at high temperatures in response to a stress in an a-direction may be the result of the independent, two-dimensional plastic distortion of each individual plane of carbon atoms. On the model, the distortion within each plane is produced by the movement of unit c-axis dislocations, mainly by climb from a generalized Herring–Nabarro mechanism. This distortion has some bearing on creep in polycrystalline graphite at high temperature and under neutron irradiation. Author

N68-16623*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
GLASS-, BORON-, AND GRAPHITE-FILAMENT-WOUND RESIN COMPOSITES AND LINERS FOR CRYOGENIC PRESSURE VESSELS
Morgan P. Hanson Washington Feb. 1968 18 p refs
(NASA-TN-D-4412) CFSTI: HC $3.00/MF $0.65 CSCL 11D

An experimental investigation was conducted to determine the tensile-strength properties of glass, boron, and graphite composites at 75°, −320°, and −423° F. Composite tensile-strength and interlaminar-shear-strength tests were made of rings. Tensile strengths of boron filaments were determined at 75° and −320°F. Strengths of glass composites were about 29 percent higher at cryogenic temperatures than at ambient temperature. Boron and graphite composite strengths were essentially the same in the temperature range investigated. Interlaminar shear strength in glass composites also increased from 75° to −320°F; boron and graphite showed no significant change within the temperature range. Filament translation efficiencies ranged from 58 to 69 percent for the materials investigated. Aluminum-foil liners that were adhesively bonded to the internal surface of glass-filament-wound cylinders withstood pressure cycling to 2.5 percent strain for a cyclic life ranging from 14 to 165 cycles at cryogenic temperatures. Liner failures were associated with buckling of the seam areas. Author

N68-16725# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE EFFECT OF FILLERS ON THE THICKENING POWER OF LITHIUM SOAPS
I. G. Fuks, V. V. Vaynshtok, and N. I. Chernozhukov 24 Jul. 1967 11 p refs Transl. into ENGLISH from Khim. i Tekhnol. Topliv i Masel (Moscow), no. 2, 1966 p 24–26
(FTD-HT-67-225; AD-663358)

The thickening effect of lithium soap in three-component systems (oil-soap-filler) depends on the nature of the filler, its concentration, and the nature of the dispersing medium. The addition of fillers (mica or graphite) to lithium greases thickened with a constant quantity of soap increases their strength and viscosity in proportion to the concentration of the filler. In castor-oil greases, the addition of mica increases viscosity and yield value more than graphite does. In cable-oil greases, these two fillers have about the same effect. The addition of up to 10% of mica to greases having constant soap-oil ratio (1:4) increases their yield value. Further increase of filler content to 40% decreases the strength. An increase in graphite concentration gradually decreases the yield value of the grease. The variation of the viscosity of greases with increasing concentration is of external character. Author (TAB)

N68-16783*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MAGNETIC SUSCEPTIBILITY OF GLASSY CARBON
D. B. Fischbach 1 Feb. 1968 12 p refs
(Contract NAS7-100)
(NASA-CR-93141; JPL-TR-32-1151) CFSTI: HC $3.00/MF $0.65 CSCL 11B

The magnetic susceptibility of two grades of Japanese glassy carbon has been measured at room temperature as a function of magnetic field strength, heat treatment temperature, and high-temperature tensile deformation. The magnetic behavior was correlated with impurity content and with interlayer spacing and apparent crystallite layer diameter. The structure sensitivity of the diamagnetism of nongraphitizing carbons, such as glassy carbon, is compared with that of graphitizing carbons, and some differences are noted and discussed. Author

N68-16787# Thiokol Chemical Corp., Brigham City, Utah. Wasatch Div.
ADVANCED CASTABLE FLARE ILLUMINANT Final Report
John M. McDermott Crane, Ind. Naval Ammunition Depot Aug. 1967 51 p Sponsored in part by AF
(Contract N00164-67-C-0359)
(TWP-0267-910; NAD-CRANE-RDTR-99; AD-663100)

A feasibility study for the casting of a 4.5 inch diameter illuminating flare is reported. A limited evaluation of the flares is conducted. The flares are cast with a polyester-epoxy binder system and utilize magnesium as a fuel and sodium nitrate as the oxidant. A liner system between the composition and the aluminum candle case is described. Author (TAB)

N68-16894# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NEW CERMET ANTIFRICTION MATERIALS FOR RUBBING PARTS [NOVYYE METALLOKERAMICHESKIYE ANTIFRIKTSIONNYYE MATERIALY DLYA UZLOV TRENIYA]
I. V. Vasil'yev and L. F. Yemets 21 Jul. 1967 15 p Transl. into ENGLISH from Akad. Nauk SSSR. Nauchn. Sov. Po Treniyu i Smaz. Teor. Smaz. Deystviya i Novyye Mat. (USSR), 1965 p 188–194
(Contract AF 33(657)-16408)
(FTD-HT-67-251; AD-663355)

The wear and antifriction properties of sintered metal materials consisting of matrices of low-carbon steel, stainless steel 1Kh18N9T, bronze, and nickel, unsaturated and vacuum saturated with teflon, were investigated on friction apparatus MT-7 at a load of 20 kg/sq cm and 0.03 m/sec. It was found that the wear of low carbon steel and nickel-based materials was very high, while bronze and stainless steel materials gave similar wear and friction results with teflon saturated matrices giving vastly improved characteristics: bronze-wear - 0.0001-1.0035 gm/hr, coefficient of friction 0.01-0.05 for teflon saturated vs 0.18-0.22 and 0.28-0.32 for unsaturated; steel--6 x 10-5-0.08 and 0.01-0.09 saturated vs 0.09-0.22 and 0.22 unsaturated. Bearing tests conducted in 30 and 60% nitric acid and in 1% caustic soda solution showed that saturated 1Kh18N9T material on chrome-plated 1Kh18N9T surface and saturated bronze on 1Kh18N9T gave best results respectively. End seals operating in 30% nitric acid showed least wear and friction when made of saturated 1Kh18N9T material rubbing against a chrome surface. Author (TAB)

N68-16912# Air Force Systems Command, Wright-Patterson AFB, Ohio. Translation Div.
TECHNOLOGY OF CARBON–GRAPHITE MATERIALS [TEKNOLOGIYA UGLEGRAFITOVYKH MATERIALOV]
Ye. F. Chalykh 16 May 1967 296 p refs Transl. into ENGLISH of the book Tekhnologiya Uglegrafitovykh Materialov, Moscow, Gostoptekhizdat., 1963 p 1–304
(FTD-MT-65-132; AD-663368)

The book presents an outline of the characteristics and properties of carbon-graphite materials. Detailed information is given on the technology of their preparation, the selection of initial materials, their preparation for the composition of industrial recipes, the technology of bulk production, pressing, sintering, graphitizing, impregnation, and packing. Author (TAB)

N68-17101*# Whittaker Corp., San Diego, Calif. Narmco Research and Development Div.
THE DEVELOPMENT OF STRUCTURAL ADHESIVES SYSTEMS SUITABLE FOR USE WITH LIQUID OXYGEN Annual Summary Report, 1 Jul. 1963–30 Jun. 1964
Rex B. Goswell, Edward S. Harrison, Jerome Hollander, Beatrix Y. Sanders, and Floyd D. Trischler Jul. 1964 136 p refs (Declassified)
(Contract NAS8-11068)
(NASA-CR-61528) CFSTI: HC $3.00/MF $0.65 CSCL 11I

A highly fluorinated aliphatic polyurethane has been prepared which is LOX compatible. Three additional fluorinated polyurethanes have been prepared which are being tested for LOX compatibility. Preparations or synthetic studies have been carried out on additional

monomers including fluorinated and chlorinated diisocyanates, hydroxyl-terminated polyesters, and hydroxyl-terminated polyethers. A number of other halogenated polymers such as polyamides, polyesters, and polyethers have been synthesized. Author

N68-17212# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.
MEASUREMENT OF THE DENSITY OF URANIUM DIOXIDE AND URANIUM CARBIDE SAMPLES IRRADIATED AT LOW TEMPERATURE [MESURES DE DENSITES D'ECHANTILLONS DE BIOXYDE D'URANIUM ET DE CARBURE D'URANIUM IRRADIES A BASSE TEMPERATURE]
William David Kingery, Yes Kauffmann, Michel Bruet, Bruno de Bernardy de Sigoyer Jul. 1967 18 p refs In FRENCH
(CEA-R-3289)

Density measurements at 21°C and after annealing for 10 hours at 400°C have been carried out on uranium dioxide and uranium carbide samples previously irradiated at low temperature up to values of 0.86×10^{16} and 0.83×10^{17} fissions/cm^3. The changes in the density before and after irradiation are compared with measurements of lattice parameter change. In the case of uranium dioxide, the agreement is satisfactory for an exposure of 0.86×10^{16} fissions/cm^3. On the other hand, for an exposure of 0.83×10^{17} fissions/cm^3 the decrease in the density is greater than what could have been expected from the increase in lattice parameter. Author (NSA)

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N68-16165*# Wolf Research and Development Corp., Bladensburg, Md.
POWER SERIES REPRESENTATION OF PARTIAL DERIVATIVES REQUIRED IN ORBIT DETERMINATION
A. F. Schanzle Oct. 1967 93 p
(Contract NAS5-9756-59)
(NASA-CR-92681) CFSTI: HC $3.00/MF $0.65 CSCL 12A

In order to solve the problem of computer time required to obtain partial derivation for estimating oribital parameters in satellite data reduction, a numerical method is presented which gives the required partial derivatives as a by-product of the integration scheme. A numerical procedure in which only one input parameter must be changed in order to obtain a higher degree of accuracy is given, along with a method of obtaining expressions for the partial derivatives. In the analytical development of the recursive relations for the two-body problem, mathematical models are given to determine how fast the coefficients converge for the assumed series solution and the series for the partial derivatives. Equations defining the motion of a close earth satellite perturbed by the second, third, and fourth zonal harmonies are also covered. B.S.D.

N68-16178# Stanford Univ., Calif. Dept. of Computer Science.
THEORY OF NORMS
F. L. Bauer 31 Aug. 1967 139 p Sponsored by NSF
(CS-75; PB-175793) CFSTI: HC $3.00/MF $0.65

Theoretical concepts concerning conformal mappings; normed vector spaces; and boundary value problems are presented. Norm transformations and invariance groups; eigenvalue exclusion theorems; and replete generating sets are included in the calculations discussed. L.S.

N68-16187# California Univ., Los Angeles. Numerical Analysis Research.
A GENERALIZATION OF NEWTON'S METHOD WITH AN APPLICATION TO THE EULER-LAGRANGE EQUATION
Richard Alfred Tapia (Ph.D. Thesis) Oct. 1967 106 p refs
(Contract Nonr-233(76))
(Rept.-67-7; AD-663288)

The paper presents a procedure for approximating the zeros of a nonlinear operator P from a Banach space X to a Banach space Y. This procedure is general enough to include the generalized Euler-Lagrange equation. The procedure presented is called the weak Newton method and is a generalization of L. V. Kantorovichs Newtons method. TAB

N68-16232*# Santa Clara Univ., Calif.
SOME APPLICATIONS OF ALGEBRAIC METHODS
G. J. Thaler and D. D. Siljak [1967] 136 p refs
(Contract NAS2-2609)
(NASA-CR-73183) CFSTI: HC $3.00/MF $0.65 CSCL 12A

The applicable parameter plane equations are derived, and a digital computer program based on these equations is presented, for identical filter sections in a feedback control system using cascade compensation. Specific applications of the program are given, and a generalized equation for extending the program to higher order systems is discussed. In order to determine the transient response of nonlinear systems with two nonlinearities, a family of describing function curves are computed and plotted on the α-β parameter plane. When these curves are superimposed on the regular parameter plane curves, the M-locus, representing the curve along which the M-point moves when the system is in dynamic operation, can be determined. This curve is potentially a valuable design tool since its graphical presentation indicates at a glance the range of variations of the roots. This permits prediction of a desired location of the describing function curve, which in turn implicitly defines the required characteristics of the nonlinear element. A parameter plane method is developed to determine the asymmetrical oscillations for different values of system parameters and input signals in nonlinear control systems. A limit cycle modification of the nonlinear characteristic of slowly-varying signals is presented as a design technique for application to plant adaptive control systems where a sinusoidal signal is used for identification. E.J.S.

N68-16280# Stanford Univ., Calif. Dept. of Computer Science.
LEAST SQUARES, SINGULAR VALUES AND MATRIX APPROXIMATIONS. AN ALGOL PROCEDURE FOR COMPUTING THE SINGULAR VALUE DECOMPOSITION
Gene H. Golub and Peter Businger (Texas Univ., Austin, Tex.) 31 Jul. 1967 22 p refs Presented at the Conf. on Basic Problems of Numerical Mathematics, Libbie, Czech., 11–15 Sep. 1967 Sponsored in Part by NSF and ONR
(CS-73; AD-662883)

The singular value decomposition plays an important role in a number of least squares problems. The report illustrates this with some examples. TAB

N68-16322*# Brown Univ., Providence, R. I. Center for Dynamical Systems.
ON THE RANGE OF UNBOUNDED VECTOR VALUED MEASURE
Czeslaw Olech [1967] 13 p refs
(Grant NGR-40-002-015; Contract DA-31-124-ARO(D)-270)
(NASA-CR-92714) CFSTI: HC $3.00/MF $0.65 CSCL 12A

Theorems are given to describe the range of a vector valued measure in which the range remains convex, as seen from the Liapunov theorem, but need not be closed. Author

N68-16400*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE X^2 STATISTIC AND THE GOODNESS OF FIT TEST
Peter D. Argentiero, Robert A. Morris, and Robert H. Tolson Oct. 1967 135 p refs
(NASA-TM-X-63100; X-551-67-519) CFSTI: HC $3.00/MF $0.65 CSCL 12A

The probability density function of the X^2 statistic is derived. The applicability of the X^2 statistic to goodness of fit tests and its approximation by the chi-square statistic are discussed in some detail. Tables of critical values of the X^2 statistic are provided for a range of sample sizes N and equiprobable categories K which will prove useful in goodness to fit tests. An example is given to demonstrate that the proper application of tables of critical values of X^2 can add considerable precision to a goodness of fit test when small samples are involved. Author

N68-16420# Ballistic Research Labs., Aberdeen Proving Ground, Md.
NUMERICAL DIFFERENTIATION USING ORTHOGONAL POLYNOMIALS
George H. Jonas Nov. 1967 29 p ref
(BRL-1380; AD-663363)

The present method of reducing data by formulating a polynomial, taking the derivative and substituting experimental values, has been simplified for instances where the independent variable is evenly spaced and the derivative is desired at these given points only. Orthogonal polynomials, resembling Legendre polynomials, are differentiated and tabulated in a useful form. When used in conjunction with available orthogonal polynomial tables, these new tables give derivatives more readily than the usual procedure. These tables present coefficients for obtaining first derivatives at 6 to 21 evenly spaced points. This report extends the available orthogonal polynomial tables to sixth and seventh degrees, when appropriate, and gives a demonstration of the method. Author (TAB)

N68-16432# Weapons Research Establishment, Salisbury (Australia).
THE PARAMETER ESTIMATION PROBLEM IN MATHEMATICAL MODELLING
J. S. Allison Nov. 1966 77 p refs
(WRE-SAD-41) CFSTI: HC $3.00/MF $0.65

The method of least squares is applied to the problem of estimation of parameters of a physical system using input–output records obtained from the system when in operation. This is done by forcing a mathematical model of the system with the measured input and adjusting model parameters so as to minimize the mean squared difference between the measured and the model outputs. Two different methods for minimizing the mean squared error are described and some comparisons made between them with the aid of specially designed experiments. In addition, it is shown that one of the techniques, derived from classical sensitivity analysis, is identical in principle with another widely used technique, the method of quasilinearization. Finally, some consideration is given to the problem of assessing the accuracy of parameter estimates. Author

N68-16496# Naval Air Development Center, Johnsville, Pa. Aero Mechanics Dept.
AUTOMATIC CONTROL SYSTEM SYNTHESIS TECHNIQUES. PHASE 1: SURVEY OF FREQUENCY DOMAIN SYNTHESIS TECHNIQUES BASED ON THE ROOTS OF THE CHARACTERISTIC EQUATION Phase Report
James C. Duke 14 Sep. 1967 33 p refs
(NADC-AM-6731; AD-658506)

This report is a survey of analytical and graphical techniques which determine the values of the feedback parameters of a linear feedback system required to yield desired values of the dominant roots of the characteristic polynomial. Two types of systems were analyzed; single-input/single-output and multiple-input/multiple-output. The intent of this survey is to examine material which will be of interest in the development of a new synthesis technique which can be utilized to design automatic flight control systems. Author (TAB)

N68-16515# Duke Univ., Durham, N. C.
A PATTERN CALCULUS FOR TENSOR OPERATORS IN THE UNITARY GROUPS
L. C. Biedenharn and J. D. Louck (Los Alamos Sci. Lab.) [1967] 75 p refs Sponsored in part by Army, NSF, and AEC
(AD-662755) CFSTI: HC $3.00/MF $0.65

For a large class of tensor operators in U(n), a surprisingly simple diagrammatic calculus of patterns is shown to exist; to each operator of this class a pattern may be assigned in terms of which the complete algebraic formula for all matrix elements may be read off directly. The class of operators includes all fundamental, elementary and extremal Wigner operators in all U(n). Application of the pattern calculus toward the explicit determination of all tensor operators is discussed. Author (TAB)

N68-16570*# Maryland Univ., College Park. Computer Science Center.
CONVERGENCE THEOREMS FOR GAUSS–SEIDEL AND OTHER MINIMIZATION ALGORITHMS
Richard Michael Elkin Jan. 1968 125 p refs
(Grant NsG-398)
(NASA-CR-93159; TR-68-59) CFSTI: HC $3.00/MF $0.65 CSCL 12A

Iterative minimization algorithms are studied for functionals defined on E^n and convergence theorems are obtained. First, a general review of convexity for functionals is given. Then, the two aspects of an iterative minimization algorithm—the direction in which the next iterate is sought and the step-size—are independently analyzed. In the analysis of direction emphasis is placed on the Gauss–Seidel and the block Gauss–Seidel methods rather than on gradient methods. A variety of step-size algorithms are studied including minimization, Curry, over-relaxed Curry, use of one Newton step and the methods of Altman, Armijo, and Goldstein. Finally, complete convergence theorems are given for representative algorithms. Author

N68-16603# Naval Postgraduate School, Monterey, Calif.
A BAYESIAN RELIABILITY GROWTH MODEL
Stephen M. Pollock Jun. 1967 70 p refs
(TR/RP-80; AD-663279)

A model is presented for the reliability growth of a system during a test program. Parameters of the model are assumed to be random variables with appropriate prior density functions. Expressions are then derived that enable estimates (in the form of expectations) and precision statements (in the form of variances) to be made of (1) projected system reliability at time tau after the start of the test program; (2) system reliability after the observation of failure data. Numerical examples are presented, and extension to multi-mode failures is mentioned. Author (TAB)

N68-16633*# Maryland Univ., College Park. Computer Science Center.
FINITE DIFFERENCE FORMS CONTAINING DERIVATIVES OF HIGHER ORDER
Manfred Reimer Jan. 1968 27 p refs
(Grant NsG-398)
(NASA-CR-93158; TR-68-60) CFSTI: HC $3.00/MF $0.65 CSCL 12A

The use of finite difference methods for the numerical treatment of initial value problems depends on two concepts, namely stability and degree of approximation. The latter can be improved significantly if derivatives of higher order are used. In this report, the stability problem is solved for such generalized finite difference schemes. Author

N68-16642# Battelle Memorial Inst., Richland, Wash. Pacific Northwest Lab.
GENERATION AND BLOCKING OF EXPERIMENTAL POINTS FOR FRACTIONAL FACTORIALS
J. A. Mahaffey and J. E. Schlosser Oct. 1967 45 p refs
(Contract AT(45-1)-1830)
(BNWL-336) CFSTI: HC $3.00/MF $0.65

The use of computer programs in designing experiments having factorial treatment arrangements for two, three, and four level designs is explained. The input and output are discussed and illustrated by examples, and a print-out of the programs and subroutines is included. Further possibilities for applications of these programs are suggested. Author (NSA)

N68-16657# Oak Ridge National Lab., Tenn.
MINIMAL WEINSTEIN DISCS IN A SUBSPACE
William Lewis Morris (Ph.D. Thesis, Tenn. Univ.) Nov. 1967 55 p refs
(Contract W-7405-ENG-26)
(ONRL-4151; UC-32) CFSTI: HC$3.00/MF$0.65

The problem of determining for a given matrix the minimal Weinstein Disc over all vectors from a specified subspace is analyzed. NSA

N68-16756# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A METHOD FOR SYSTEM RELIABILITY ANALYSIS
B. P. Zelentsov 1 Aug. 1967 11 p refs Transl. into ENGLISH from Izv. Sibirsk. Otd. Akad. Nauk SSSR (Novosibirsk), no. 2, 1965 p 44–48
(FTD-HT-23-501-67; AD-663354)

The known mathematical models for system reliability analysis are based either on the mass servicing theory or on the theory of simple homogeneous Markov circuit with finite number of states. The first approach requires the establishment of a large number of differential equations while the second often demands the application of high order matrices. The present author proposes a new more direct method which, after relatively simple calculations, yields the average time for the restoration of the system into its stationary state. It is based on a solution proposed earlier by Einhorn (S. J. Einhorn, Reliability prediction for repairable redundant systems. Proc. IEEE, 1963, vol. 51, no. 2) for the case of one kind of element with identical reliability indexes. The author assumes that (1) the time of flawless operation and the time of element restoration follow the exponential distribution; (2) malfunctions and repairs of the system are mutually independent; (3) all elements which are in good order are under hot operating conditions while the failing elements are out of operation; and (4) at a single instant of time there can occur only single transitions of an element from its operating state into a malfunctioning state and vice versa. The method is illustrated by an evaluation of a two-element system with four available states. Results show that the new method is faster than the existing methods. TAB

N68-16907# Stanford Univ., Calif. Computer Science Dept.
CHEBYSHEV APPROXIMATION OF CONTINUOUS FUNCTIONS BY A CHEBYSHEV SYSTEM OF FUNCTIONS
G. H. Bolub and L. B. Smith 28 Jul. 1967 57 p refs Sponsored in part by NSF
(CS-72; PB-175810) CFSTI: HC$3.00/MF$0.65

The second algorithm of Remez can be used to compute the minimax approximation to a function, f (x), by a linear combination of functions, (Q sub i (x)) subscript O, superscript N, which form a Chebyshev system. The only restriction on the function to be approximated is that it be continuous on a finite interval (a,b). An Algol 60 procedure is given which will accomplish the approximation. This implementation of the second algorithm of Remez is quite general in that the continuity of f (x) is all that is required whereas previous implementations have required differentiability, that the end points of the interval be 'cricital points,' and that the number of 'critical points,' be exactly N+2. Discussion of the method used and its numerical properties is given as well as some computational examples of the use of the algorithm. The use of orthogonal polynomials (which change at each iteration) as the Chebyshev system is also discussed. Author

N68-17002# National Bureau of Standards, Washington, D. C.
FRACTIONAL FACTORIAL EXPERIMENT DESIGNS FOR FACTORS AT TWO LEVELS
15 Apr. 1967 90 p
(NBS-AMS-48; PB-176119) CFSTI: HC$3.00/MF$0.65

The experiment plans presented herein make available in one place a large collection of fractional factorial designs in which each factor is at two levels. These plans are useful in many experimental situations where it is necessary to evaluate the joint effects of many factors. This work was carried out in the Statistical Engineering Laboratory of the National Bureau of Standards. The monograph contains fractional replicate designs for n=5 (1)16 and for a range of p=1,2,3,4,5,6,7,8. The designs have been constructed such that the 2 (n–p) treatments are divided into 2 (s) blocks (columns) containing 2 (n–p–s) treatments each. This latter condition allows for one-way elimination of heterogeneity, with a consequent reduction in the experimental error. Also some of the designs have had the treatments arranged within the blocks so as to allow for two-way elimination of heterogeneity, i.e., double confounding—both rows and columns. This feature of the designs is useful when the position within the block affects the outcome of the measurement. Author

N68-17013# Wisconsin Univ., Madison. Dept. of Statistics.
SIMPLIFIED TECHNIQUES FOR ESTIMATING PARAMETERS OF SOME GENERALIZED POISSON DISTRIBUTIONS
Paul Hinz and John Gurland Apr. 1967 46 p refs
(Contract PHS-CA-08086-02)
(TR-112; PB-175732) CFSTI: HC$3.00/MF$0.65

Three similar procedures for parameter estimation are investigated for the Negative Binomial, Neyman Type A, Poisson Pascal, and Poisson Binomial distributions. These procedures are based on h-functions, h-functions combined with an a-function of the zero frequency, and l-functions. The estimators so obtained are of the same form as weighted least squares. In comparing the estimation procedures for a given number of functions, use of h sub 0, h sub 1, ..., h sub s, a sub i) generally results in the highest asymptotic relative efficiency. In some parts of the parameter space of the Poisson Binomial distribution, the l-functions have the highest efficiency. The use of two or three h-functions together with an a-function is very effective and yields fittings that rival maximum likelihood. A graphical procedure based on the h- and l-functions for helping to choose among the four distributions is also presented. In making such a choice in the absence of preliminary information about the relevant underlying distribution, this graphical procedure has some merit. Author

N68-17077*# Brown Univ., Providence, R. I. Center for Dynamical Systems.
VARIATIONAL PROBLEMS INVOLVING FUNCTIONAL DIFFERENTIAL EQUATIONS
H. T. Banks [1967] 44 p refs
(Grants NGR-40-002-015; AF-AFOSR-693-67)
(NASA-CR-92710) CFSTI: HC$3.00/MF$0.65 CSCL 12A

Necessary conditions in the form of an integrated maximum principle are obtained for problems with quite general nonlinear functional differential systems, including many integro-differential systems and variable or constant time lag systems. Integrals are either Lebesgue or Lebesgue–Stieltjes integrals, and Lebesgue measurable functions are generally used. The functional or differential equation solution is an absolutely continuous one which satisfies the equation almost everywhere with respect to Lebesgue measure. Vector matrix notations are used, and a general extremal problem is formulated for functional differential systems. A theorem concerning necessary conditions for extremals is given, and proofs for this involve a generalization of the idea of quasiconvex families. This theorem is then applied to control problems, and an example of a specific functional control problem is included. It is shown that the necessary condition in terms of variations can be used to derive a general maximum principle involving multipliers or adjoint variables. M.W.R.

N68-17109# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
MAXIMUM LIKELIHOOD NONLINEAR CORRELATED FIELDS (BATTELLE-NORTHWEST PROGRAM LIKELY)
Bernard H. Duane Sep. 1967 111 p refs
(Contract AT(45-1)-1830)
(BNWL-390) CFSTI: HC$3.00/MF$0.65

Battelle-Northwest program LIKELY constructs maximum likelihood multidimensional vector fields satisfying any statistical-or-deterministic linear-or-nonlinear vector field theory cast as a variational extremal subject to correlated-statistic or implicit-anholonomic constraints. Author (NSA)

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N68-16139# Weather Bureau, Silver Spring, Md. Data Acquisition Div.
RECENT DEVELOPMENTS IN HIGH ALTITUDE METEOROLOGICAL SOUNDINGS IN THE USA
Vaughn D. Rockney Jun. 1967 42 p
(WBTM-DATAC-1; PB-175679) CFSTI: HC$3.00/MF$0.65

The report describes efforts of the U. S. A. to obtain rawinsonde data routinely to altitudes of 31 km (i.e., 10 mb.) and data by rockets to 65 km (i.e., 0.1 mb). Equipment in use and networks of stations are outlined and operational problems are discussed. Author

N68-16177# Atmospheric Research and Development Corp., Kansas City, Mo.
SNOW FORECASTING PROCEDURES IN THE CENTRAL UNITED STATES Final Report
Howard H. Hanks, Jr., Dean R. DeHarpporte, and Eugene C. Grueber Jun. 1967 39 p refs
(Contract CWB-11353)
(PB-175804) CFSTI: HC$3.00/MF$0.65

The synoptic approach is employed in developing methods of predicting snowfall, with emphasis on snow storms producing 4 inches or more of snow. Data were obtained for winter storms in the central United States for a nine year period ending in 1967. Routinely measured synoptic parameters available on operational NMC charts were related to criteria for snowfall, the placement and width of the 2 and 4 inch total snowfall, a single point forecast of 2 inches or more of snow, and 6 and 12-hourly distributions of snow. The total snowfall for a given area was determined by use of the maximum vorticities, at sea-level and 500 mb. It was concluded that the most effective single parameter separating rain from snow for elevations near and below 1000 feet M. S. L. is the 2840-m. 1000-700-mb. thickness line. The most accurate parameters for predicting the maximum total snowfall are sea-level relative geostrophic vorticity, 500-mb. relative vorticity, and 850-mb. dew point. Successful correlation of the width of the snow band to various synoptic parameters permits fairly accurate placement of the axis of heaviest snow and the northern edge of the snow band. Author

N68-16326# Oklahoma Univ. Research Inst., Norman. Dept. of Meteorology.
EXAMINING THE NATURE OF CONVECTIVE AND OROGRAPHIC CLOUD SYSTEMS USING SATELLITE CLOUD PHOTOGRAPHS Final Report, 1 Jun. 1965–31 May 1967
Yoshikazu Sasaki Jun. 1967 157 p refs
(Grant ESSA-WBG-57)
(ARL-1515-2; PB-175998) CFSTI: HC$3.00/MF$0.65

CONTENTS:

1. A GENERALIZED THEORY OF RAYLEIGH CONVECTION APPLICABLE TO THE ATMOSPHERE. PART 1: CONDUCTIVE AND RADIATIVE BOUNDARY CONDITION WITH KINEMATIC FREE BOUNDARY CONDITION IN NON-ROTATING FIELD Y. Sasaki 35 p refs (See N68-16327 07-20)

2. EFFECTS OF LARGE-SCALE SUBSIDENCE ON CELLULAR CONVECTION IN THE ATMOSPHERE: A NUMERICAL EXPERIMENT S. L. Barnes 115 p refs (See N68-16328 07-20)

N68-16327# Oklahoma Univ. Research Inst., Norman. Dept. of Meteorology.
A GENERALIZED THEORY OF RAYLEIGH CONVECTION APPLICABLE TO THE ATMOSPHERE. PART 1: CONDUCTIVE AND RADIATIVE BOUNDARY CONDITION WITH KINEMATIC FREE BOUNDARY CONDITION IN NON-ROTATING FIELD
Yoshikazu Sasaki *In its* Examining the Nature of Convective and Orographic Cloud Systems Using Satellite Cloud Phot. Jun. 1967 35 p refs (See N68-16326 07-20)

Rayleigh's thermal convection theory is generalized to include the effects of radiation and forced conduction at the top and bottom boundaries of the layer. Possible existence of such a thermal boundary condition in the atmosphere is discussed. Kinetic boundary conditions are taken as the plane solid surface and the "free" (or slip) condition at both boundaries. For these boundary conditions the principle of exchange of stabilities is proved, and the eigenvalues of the governing differential equation at the marginal state obtained numerically. The results show that the eigenvalues are largely influenced by the ratio (γ) of radiative heat transfer to the conductive heat transfer at the boundaries. The critical Rayleigh number (Ra_c) decreases as the ratio decreases and Ra_c approaches a value of approximately 120 as γ approaches zero. Dependency of the eigenvalues upon the thermal ratio is large for the lowest eigen mode, but the ratio exerts small effect on the other eigen modes. The ratio of the depth of convection layer to the horizontal wave length decreases also as γ decreases, which indicates that the flat convection cells are developed when the conductive heat transfer predominates over the radiative heat transfer at the boundaries. Author

N68-16328# Oklahoma Univ. Research Inst., Norman. Dept. of Meteorology.
EFFECTS OF LARGE-SCALE SUBSIDENCE ON CELLULAR CONVECTION IN THE ATMOSPHERE: A NUMERICAL EXPERIMENT
Stanley L. Barnes (Ph.D. Thesis) *In its* Examining the Nature of Convection and Orographic Cloud Systems Using Satellite Cloud Phot. Jun. 1967 115 p refs (See N68-16326 07-20)

Numerical solutions are obtained for a set of linearized, variable-coefficient, differential equations governing convective motions in a shallow, stably-stratified layer continuously heated at its base. The boundary conditions include a rigid, conducting upper boundary and an open lower boundary with a constant excess temperature. The basic state is subsiding and has a temperature distribution which varies with height. With assumed sinusoidal horizontal perturbations of excess temperature, the development and energetics of convective cells are studied for wave lengths 1 to 100 km, both with and without subsidence. The effects of horizontal and vertical eddy diffusion, Coriolis, and radiation are included. The model approximates conditions in the capping stable layer associated with the weak, cellular convective cloud patterns of scale 10 to 100 km observed from satellites. After initial growth of the convective cell from the lower boundary, an upper couplet circulation is organized. Cells less than 10 km wave length amplify at first, but soon reach a steady state. Cells greater than 10 km continue to amplify with time, the maximum growth occurring for wave lengths 10 to 20 km. Subsidence affects the cell development by enhancing the growth rate in the early stages and damping it several hours later. Author

N68-16394# Imperial Coll. of Science and Technology, London (England). Dept. of Meteorology.
CONVECTION IN AND BELOW CUMULUS
M. J. Bader (M.S. Thesis) May 1967 80 p refs
CFSTI: HC $3.00/MF $0.65

This paper deals with some aspects of the region of small scale convection which occupies a layer of few kilometers above the earth's surface. Energy from the ground is transported upwards by elements of buoyant air which, upon condensing, form cumulus clouds. The nature of the rising air below and above the condensation level together with some factors which affect the region of small scale convection are discussed. Author (ESRO)

N68-16442# Library of Congress, Washington, D. C. Aerospace Technology Div.
HAIL PREVENTION RESEARCH Surveys of Foreign Scientific and Technical Literature
Daniel W. Michaels 8 Dec. 1967 39 p refs *Its* Work Assignment No. 101
(ATD-68-26-101-1; AD-663226)

Contents: Experimental cloud modification testing ranges; Instrumentation; Ice nucleants; VGI technique (Alazan Valley experiments); Samsari Range experiments; Moldavian Range experiments; Ukrainian Range experiments; Gissar Valley experiments; Chinese experiments; Polish experiments. TAB

N68-16487# Naval Oceanographic Office, Washington, D. C.
EVALUATION OF SPECTRAL WAVE HINDCASTS USING THE AUTOMATED WAVE PREDICTION PROGRAM OF THE NAVAL OCEANOGRAPHIC OFFICE
Lionel I. Moskowitz 25 Oct. 1967 39 p refs
(IR-67-78; AD-663117)

For the past few years a spectral wave forecasting program has been under development at the Naval Oceanographic Office. Primarily designed as a first step for an automated aircraft carrier landing system this model, at present, represents the state of the art in ocean wave forecasting. The first section of this paper presents a brief historical summary and description of the wave forecasting model. In conjunction with New York University a forecast/hindcast evaluation program has been undertaken. The second section of this paper attempts to evaluate spectral hindcasts made in the vicinity of Bermuda, B.W.I. during the latter part of November 1961. Wave data recorded at ARGUS ISLAND, situated 25 miles SW of Bermuda, are the sole means of evaluation for the hindcasts. Comparisons of hindcasted to observed spectra are quite favorable. Rapidly changing synoptic conditions appear to be the major cause for discrepancies in the spectral comparisons. Modifications to the model for improved spectral forecasts are also discussed. Author (TAB)

N68-16491# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
INFRARED IMAGING IN THE 10–12.6 MICRON BAND FROM A SYNCHRONOUS ALTITUDE EARTH SATELLITE
F. W. Schenkel and D. K. Anand Oct. 1967 42 p refs
(Contract NOw-62-0604-c)
(TG-948; AD-663265)

Infrared imaging of the earths cloud cover from a satellite would permit determination of cloud height. This report describes what is felt to be an optimum state-of-the-art system design, detector, and cooler for an infrared imaging radiometer. This system consists of a HgCdTe quantum detector imaging in the 10 to 12.6 micron region from a gravity-gradient-stabilized satellite. In a synchronous-orbiting satellite this system could have a spatial resolution of 5 n. miles and a thermal resolution of 3K for a scene temperature of 200K. The selection of the 10 to 12.6 micron band is most appropriate from the standpoint of maximum available energy, as well as that of available atmospheric window and adequate image contrast. Analysis of detector cooling indicates that passive cooling would not be sufficient for the projected mission and that, therefore, the coolers should be mounted on steering frames or a sun shade system should be used. Author (TAB)

N68-16514# Meteorology Research Inc., Altadena, Calif.
ARIZONA WEATHER MODIFICATION PROGRAM Research Reports, for 1965–1967
Paul B. MacCready, jr. 30 Apr. 1967 168 p refs
(Contract DI-14-06-D-5589)
(MRI66-FR-457; PB-175775)

Contents: Cloud Dynamics (cloud buoyancy increase due to seeding, cloud dynamics, and precipitation model, traveling mesoscale systems); Natural and Artificial Nuclei (environmental background of ice nuclei, generation of artificial ice nuclei, continuous ice nuclei counter, tracing of plumes of fluorescent particles and AgI, giant condensation nuclei); Case Studies of Seeding (case study of seeding of vertical-fall pyrotechnic AgI generators, case study of ground and airborne cloud seeding with silver iodide, case studies—metaldehyde seeding); The Winter Program (cloud dynamics, natural and artificial nuclei, case studies of seeding). Author

N68-16540# Miami Univ., Fla.
RADAR HURRICANE RESEARCH Final Report, 1 Sep. 1966–31 Aug. 1967
Harry V. Senn Sep. 1967 46 p refs
(Contract E-22-84-67(N))
(ML-67291)

University of Miami radar operations during hurricane Inez, October 1966, are summarized. The three-dimensional data obtained on PPI and RHI are presented along with an analysis of the rapidly changing eye structure, erratic motion, and quantitative aspects of the horizontal and vertical precipitation patterns. In general, tallest echoes tend to return strongest signal intensities; but the Inez precipitation pattern consisted of rather light rain and violated many of the previously suggested 'indicators' of hurricane motion. In an effort to determine the theoretical radio propagation conditions in and around tropical storms, refractive indices have been computed for the region below 700 mb from 185 soundings taken in 13 hurricanes and typhoon Marge. The 60 of the soundings which contained layers in which radio waves would be anomalously propagated were classified into subrefractive, superrefractive, and trapping categories. Finally, the extensive participation in Project Stormfury planning and operations during 1966–67 is summarized. Author

N68-16552# Imperial Coll. of Science and Technology, London (England). Dept. of Meteorology.
EVAPORATION
F. K. Sayem (M.S. Thesis) 12 Jun. 1967 47 p refs CFSTI: HC $3.00/MF $0.65

The removal of vapor from freely evaporating surface and the diffusion process and method of determining evaporation from them is considered. The energy balance is dealt with, especially referring to Bowen ratio and Penman's formula which combines the sink strength method of estimates with the energy balance method to give a very good estimate of evaporation from standard meteorological observations, namely mean air temperature, mean air dew point, mean wind speed at 2 meters height above the surface and duration of sunshine. Special situations on land surfaces, i.e. ice and snow, are also outlined. Finally, problems arising from horizontal advection are dealt with and variations of evaporation with latitude over oceans and lands and some measured values at different parts of the world are discussed. ESRO

N68-16582# Imperial Coll. of Science and Technology, London (England). Dept. of Meteorology.
FOG
Mervyn C. Jackson (M.S. Thesis) Jul. 1966 69 p refs Sponsored by Sci. Res. Council
CFSTI: HC $3.00/MF $0.65

A general account is given of fogs and their characteristics; the important physical processes in the formation, maintenance, and clearance of fogs; and its prediction. The methods, success, and prospects of dispersing fogs are evaluated. Author (ESRO)

N68-16674# Chicago Univ., Ill. Cloud Physics lab.
CIRRUS CLOUD SEEDING AS A TRIGGER FOR STORM DEVELOPMENT
Roscoe R. Braham, Jr. 15 Aug. 1967 12 p refs Presented at the 48th Ann. Meeting, Am. Geophys. Union, Washington, D. C., 17 Apr. 1967
(Grant NSF GP-3779)
(PB-175993) CFSTI: HC$3.00/MF$0.65

The importance of ice crystals from higher clouds appears to be their ability to trigger the organization of middle level instability. Instability that would otherwise lead to a large area but weak intensity field of disordered and small convective clouds can be funneled into a few major centers which are self propagating and which yield considerable rain to the ground. Documentation of this fact is of considerable importance to cloud seeding and weather modification, because it shows the possibility of artifically seeding unstable middle clouds to accomplish the same ends. On the other hand this study clearly shows that the natural cirrus are capable of adequately performing this role in many meteorological situations. It remains to be seen how often unstable middle clouds may occur without the presence of adequate amount of higher cirrus. Author

N68-16721# Bergen Univ. (Norway).
FURTHER STUDIES OF STATISTICAL METEOROLOGY Final Report
C. L. Godske Jun. 1967 76 p refs
(Contract AF 61(052)-760)
(AFCRL-67-0677; AD-663223)

Sections 1.1 - 1.4 present the problems, the administration of the work and reports on travel, lectures and publications. Some general comments are made as to the applications of statistical methods (2.1 - 2.5). One-dimensional distributions are commented upon in 3.1 - 3.4 and some provisional results given. Time series are presented, following lines used in econometry, in 4.1-4.7; some simple types, stationary and non-stationary, have been considered in 5.1 - 5.7, especially with respect to predictability. The importance of mixed series as models for smoothed variables and variables with non-assimilable errors has been emphasized, and a simple application made to principles of long-range forecasting. In 6.1 - 6.4 stochastic processes have been treated; in particular we have discussed the loss of information caused by grouping. Finally, in 7.1 - 7.5, some provisional results have been presented with respect to weather types (defined by H. Johansen and P. Andersen) and their use as discriminant functions for precipitation and thunderstorms. Author (TAB)

N68-16724# Stanford Research Inst., Menlo Park, Calif.
RELATIONSHIPS BETWEEN CIRCULATION PATTERNS AND SATELLITE OBSERVED CLOUD COVER: CASE 1, MARCH 9–15, 1965
Eldon J. Wiegman, Rex G. Hadfield, and Sidney M. Serebreny Aug. 1967 57 p refs
(Contract Cwb-11354)
(SR-1; PB-176277)

This case study, covering the period March 9 through 15, 1965, is concerned with the distribution of cloud patterns over the Eastern Pacific and Western United States during the presence of a blocking anticyclone centered in northern latitudes of the Eastern Pacific. Relationships between circulation patterns and satellite-observed cloud cover are discussed in terms of four general regimes: the blocking anticyclone, the trough downstream of the blocking anticyclone, the jet stream, and subtropical cloudiness south of the 30th parallel. It is concluded that certain cloud patterns during this case study were useful in delineating or detecting important circulation systems or changes therein. Author

N68-16728# Environmental Science Services Administration, Miami, Fla. National Hurricane Research Lab.
A SYNOPTIC STUDY OF TWO TROPICAL DISTURBANCES IN THE CARIBBEAN
M. A. Lateef and Clark L. Smith Apr. 1967 39 p refs
(IERTM-NHRL-78; PB-175605) CFSTI: HC$3.00/MF$0.65

The evolution of the wind and temperature fields during the passage of two tropical disturbances across the Caribbean is described with the aid of twice daily streamline and isotherm analyses at seven levels in the atmosphere as well as pertinent space cross sections. One of the disturbances moved from Puerto Rico across Cuba into the Gulf of Mexico during the period August 3 to 5, 1963, and could be classified as a lower tropospheric steady-state wave in the easterlies. The other disturbance moved westward across the Lesser Antilles and was south of Cuba on August 25, 1962. Subsequently, it moved northward to a position off the east coast of Florida and intensified into Hurricane Alma by 1200 GMT on August 28, 1962. The analyses are based on available data from the existing synoptic station network in the Caribbean and adjoining areas. An attempt is made to relate the upper-tropospheric structures of the two disturbances to developments in the lower levels. Author

N68-16731# National Meteorological Center, Suitland, Md.
DETAILED SOUNDING ANALYSIS AND COMPUTER FORECASTS OF THE LIFTED INDEX
John D. Stackpole Aug. 1967 18 p refs
(WBTM-NMC-41; PB-175928) CFSTI: HC$3.00/MF$0.65

With the recent availability of numerical means of calculating pseudo-adiabatic lapse rates, it has become possible to perform rather detailed sounding analyses in a routine operational manner. A number of stability and energetic parameters derived from sounding analysis which are computed at NMC, are described. Also, with the inclusion of various moisture parameters into the six-layer primitive equation (PE) forecast model, it is possible to make forecast of a somewhat simpler stability parameter, the lifted index. The method of calculation of this quantity and some sample forecasts are presented. Author

N68-16770# Weather Bureau, Washington, D. C. Office of Hydrology.
METEOROLOGY OF MAJOR STORMS IN WESTERN COLORADO AND EASTERN UTAH
Robert L. Weaver Jan. 1968 82 p refs
(WBTM-HYDRO-7) CFSTI: HC$3.00/MF$0.65

The 42 most intense general storms in eastern Utah and western Colorado since 1899 are studied in relation to the observed or estimated broadscale upper air circulation patterns and sources of moisture. The report summarizes individual analyses of the storms. Storms are typed by reference to the behavior of the 500-mb patterns. The role of upper Lows in transporting moisture is emphasized. Indices are developed which evaluate storm moisture, temperature and influence of topography. The relative importance to the precipitation sequence of peak mositure versus proximity of upper Lows or troughs is compared. Moisture source regions are related to storm type and season. Local topographic effects are summarized by upper wind direction. Other relationships between various factors are discussed. Author

N68-16805# Bohan (Walter A.) Co., Park Ridge, Ill.
CHARACTERISTICS OF CLOUD COVER PATTERNS OVER THE UNITED STATES
Walter A. Bohan Apr. 1967 47 p
(Contract CWB-11096)
(PB-176102)

The purpose of the selected case study series reports is to provide examples of meteorological satellite cloud photography and related synoptic weather data in a case history format. Primary emphasis is placed on cloud pattern recognition and interpretation, as an aid to operational synoptic weather analysis and forecasting.

A brief test describing the meteorological implications is usually included with each case presented. In this series, however, circumstances do not permit the addition of text on meteorological interpretations. Author

N68-16807# Brookhaven National Lab., Upton, N. Y.
A SUMMARY OF RECENT TURBULENCE MEASUREMENTS AT BROOKHAVEN NATIONAL LABORATORY
J. A. Frizzola, I. A. Singer, and N. E. Busch (Atomic Energy Res. Estab., Riso, Denmark) 29 Aug. 1967 21 p refs Presented at the AEC Micrometeorol. Res. Inform. Meeting, Chalk River, Ontario, 12 Sep. 1967 Sponsored by AEC
(BNL-11889; CONF-670931-16) CFSTI: HC $3.00/MF $0.65

A recent analysis of mean gradient and spectral measurements at Brookhaven is reviewed. Estimates of the stress derived from *mean* wind profiles compare favorably with the measured quantity $-\overline{u'w'}$. However, some of the assumptions used, particularly the constancy of the stress with height at the Brookhaven site are discussed. Spectral data are presented which indicates the vertical velocity component obeys similarity theory and those spectra agree with some recent suggestions for the shape of the w spectra. The longitudinal and lateral components, u and v, also obey the similarity hypothesis but over a smaller frequency range than the w component. The v component also appears to be more influenced by thermal stratification than the other two components. The ratio of the vertical velocity variance to the stress fits into recent suggestions concerning the shape of the spectra. Author (NSA)

N68-16808# Stanford Research Inst., Menlo Park, Calif.
RELATIONSHIPS BETWEEN CIRCULATION PATTERNS AND SATELLITE-OBSERVED CLOUD COVER—CASE 3, FEBRUARY 21–MARCH 6, 1966
Eldon J. Wiegman, Rex. G. Hadfield, and Sidney M. Serebreny Aug. 1967 68 p
(Contract Cwb-11354)
(SR-3; PB-176275)

This is the third of three case studies concerned with deducing relationships between circulation patterns and satellite-observed cloud cover that may be of analytical aid. The period February 21 through March 6, 1966, is studied using cloud data from the ESSA I satellite within the region 95 degrees W to 145 degrees W, 15 degrees N to 40 degrees N. Circulation patterns encountered during this period included: (1) A series of migratory high cells that penetrated from the high latitudes of the Central Pacific into the middle latitude of the Eastern Pacific. The first of these cells moved into the Western States. (2) A polar outbreak in the northerly latitudes of the Eastern Pacific, with periodic surges of cold air. (3) A low-pressure system in the lower latitudes of the Eastern Pacific between the migratory anticyclones. (4) Widely separated jet stream regimes. (5) Out-of-phase wave systems in the upper-air flow. Cloud cover patterns are discussed in terms of their appearance (or successive changes of appearance) during these circulation systems. Those certain cloud patterns that were useful in the analysis of important circulation systems, or the changes therein, are highlighted. Author

N68-16812*# Boeing Co., Seattle, Wash.
REVIEW OF RAWINSONDE REDUCTION METHODS
R. S. Wheeler Jan. 1968 69 p refs
(Contract NAS8-5608)
(NASA-CR-61192) CFSTI: HC $3.00/MF $0.65 CSCL 04B

Rawinsonde reduction techniques oriented specifically for computer operation are reviewed and evaluated. Equations and flow charts are used to facilitate the description of the reduction procedures. An error study is performed on rawinsonde data to determine accuracies of the tracking and sounding data. An optimal estimation technique is used to compare tracking accuracies of two of the types of rawinsonde systems, the AN/GMD-1, and the AN/GMD-2A systems. Comparison of various reduction techniques for temperature, humidity, and wind values are made to determine which best suits an accurate, computer-oriented reduction program. Incorporated in this comparison are tests to determine the best technique for digitally filtering the tracking data. Author

N68-16824# Weather Bureau, Silver Spring, Md. Techniques Development Lab.
SHORT RANGE, SUBSYNOPTIC SURFACE WEATHER PREDICTION
Harry R. Glahn and Dale A. Lowry Jul. 1967 14 p refs Presented at Joint Tech. Exchange Conf., Monterey, Calif., 4–7 Apr. 1967
(WBTM-TDL-11; PB-175772) CFSTI: HC $3.00/MF $0.65

An on-going program to develop an operating system for making objective forecasts of weather variables on a space scale of approximately 50 miles and a time scale of 1 hour up to about 18 hours is described. The system will consist of a combination of numerical (dynamic) and statistical models. Precipitation and cloudiness forecasts for the 'Today' period, 7:00 A.M. to 7:00 P.M., over the eastern United States are receiving primary emphasis. Intermediate products are hourly sea level pressure forecasts valid between 7:00 A.M. and 7:00 P.M.. It appears the sea-level pressure and precipitation forecasts are superior to the machine produced guidance forecasts presently available within NMC. Author

N68-16835# Miami Univ., Fla. Inst. of Marine Science.
THE UPPER TROPOSPHERIC AND LOWER STRATOSPHERIC STRUCTURE OF SEVERAL HURRICANES
Pancheti Koteswaram Environ. Sci. Serv. Admin. Jul. 1967 76 p refs
(Grants ESSA-29; ESSA-67)
(IERTM-NHRL-79; PB-175931) CFSTI: HC $3.00/MF $0.65

A synoptic study of several hurricanes at the time of landfall is described with particular reference to the thermal and wind structure in the upper troposphere and lower stratosphere. Features such as a peripheral ridge and a peripheral jet in the upper troposphere are described and the possible role of these features, as well as of the cold core, in the hurricane mechanism is discussed. The cold core may be caused by forces ascent above the wellknown, warm core of a hurricane. The study has also revealed that a hurricane which has recurved into the extratropical westerlies does not have an upper cold core, and its structure closely corresponds to the classical model. Tentative schematic models of the distribution of temperature and height anomalies are indicated in the case of a mature hurricane before recurvature. Author

N68-16870# Emmanuel Coll., Boston, Mass. Oriental Science Library.
AN EXPERIMENT ON THE QUANTITATIVE DESCRIPTION OF FIELDS OF CLIMATOLOGICAL ELEMENTS BY MEANS OF ORTHOGONAL FUNCTIONS
Yong-Nian Shi Bedford, Mass. AFCRL Sep. 1967 22 p refs Transl. into ENGLISH from Ch'i Hsiang Hsueh Pao (Peking), v. 35, no. 3, 1965 p 343–351
(Contract AF 19(628)-5073)
(EMM-66-89; AD-662867) CFSTI: HC $3.00/MF $0.65

The paper deals with the generalized problem of the quantitative description of fields of climatological elements by means of approximate analytical expressions. The present author is of the opinion that it is advantageous to use a linear combination of orthogonal functions as an approximate expression for the quantitative description of fields of climatological elements. A formula for the assessment of the accuracy of the computed results is also presented. Two numerical examples are given in which the descriptive equations are represented by a linear expression. The coefficients of the linear expression are determined. The initial input data are correlated with the coefficients of the descriptive equations. The standard error of estimate and the variance ratio are

computed. The importance of each linear coefficient is assessed by a comparison of the individual contribution to the multiple correlation coefficient. TAB

N68-16906# New York Univ., N. Y. Dept. of Meteorology and Oceanography.
SNOW PREDICTION IN THE EASTERN UNITED STATES Final Report
Jerome Spar, Joseph R. Bocchieri, Robert A. Godfrey, Silvio G. Simplicio, and James P. Travers Jun. 1967 81 p refs
(Contract E-12-67(N))
(TR-67-4; PB-175803) CFSTI: HC $3.00/MF $0.65

The New York City snow prediction problem was divided into three parts: prediction of starting time, discrimination between rain and snow, and estimation of snowfall amount. Only limited success has been achieved in forecasting snow starting time by kinematic extrapolation of precipitation isochrones. A practical operational method of determining the probability of snow-versus-rain was developed for New York City. A method of estimating the probabilities of light, moderate, or heavy snow at New York City associated with coastal cyclones was developed based on the sea level cyclone track, central pressure, and storm duration. Diagnostic studies of two east coastal cyclones of the winter of 1966–1967 were begun using data from a sub-synoptic network, aircraft observations, and three-hourly rawinsondes. Prognostic and diagnostic computations are being carried out at NMC with the data obtained. Author

N68-16915# Chicago Univ., Ill. Cloud Physics Lab.
A CENSUS OF CIRRUS HEIGHTS AND TEMPERATURES OVER CENTRAL UNITED STATES
Edward L. Harrington 15 Aug. 1967 16 p refs Presented at the Conf. of the Am. Meteorol. Soc., Ann Arbor, Mich., 20 Mar. 1967
(Grants NSF G-8214; NSF GP-3779)
(PB-175991) CFSTI: HC $3.00/MF $0.65

The height of cirrus having its origin in the dynamic processes and high-level convective processes of the atmosphere is intimately associated with tropopause height. Latitudinal variation in cirrus height is then explained by the latitudinal variation of tropopause height. There are important relationships between cirrus height and synoptic patterns which we have examined here only implicitly and superficially. During the summer months however a large fraction of cirrus, maybe as much as a third or a half, originates from convective processes in the lower atmosphere. Cirrus originating in this way may be found throughout a much deeper layer of the atmosphere than cirrus of conventional origin. Author

N68-16920*# Chicago Univ., Ill. Dept. of Geophysical Sciences.
A PROPOSED METHOD OF ESTIMATING CLOUD-TOP TEMPERATURE, CLOUD COVERS, EMISSIVITY, AND CLOUDNESS FROM SHORT AND LONG WAVE RADIATION DATA OBTAINED BY MEDIUM-RESOLUTION SCANNING RADIOMETERS
Tetsuya Fujita and Hector Grandoso Nov. 1967 55 p refs
(Grants NsG-333; WBG-34)
(NASA-CR-92982; SMRP-RP-48) CFSTI: HC $3.00/MF $0.65 CSCL 04B

With the knowledge that the basic approach to the interpretation of radiation data varies significantly according to the horizontal dimensions of the meteorological systems under investigation, a complete analysis of radiation data has been attempted, taking into consideration the spatial response of the sensors and cloud cover inside their field of view. It was revealed that the cloud cover observed varied according to the spectral responses of the radiometers, thus necessitating the establishment of radiometric cloud covers which can be identified as the equivalent reference cloud cover (smallest), the equivalent blackbody cloud cover, and the photographic cloud cover (largest). A method of determining the cloud emissivity was also obtained by solving general radiometric equations involving a two-radiance model. As a result of this study, it became evident that the equivalent blackbody temperatures from medium resolution radiation data cannot always be used as the cloud top temperature because of the varying emissivity of clouds and their partial coverage of the radiometers field of view. Author

N68-17011# Meteorology Research, Inc., Altadena, Calif.
ARIZONA WEATHER MODIFICATION RESEARCH PROGRAM Final Report, for 1965–1967
Paul B. MacCready, Jr. 30 Apr. 1967 129 p refs
(Contract DI-14-06-D-5589)
(MRI66-FR-407r; PB-175776) CFSTI: HC $3.00/MF $0.65

The report describes the status of the Arizona Weather Modification Research Prgram two years after its inception. The program included a small investigation of seeded and non-seeded summer storms in 1965, a brief winter field project early in 1966, a major program in the summer of 1966, and the associated planning, technique developments, and evaluation. The conduct and results of the three field projects are presented in this volume of the Final report. Twelve additional separately authored special reports are enclosed in a companion volume titled 'Arizona Weather Modification Research Program—Research Reports for FY 1965, 1966, and 1967': these represent topics in cloud dynamics, nuclei, and case studies which were covered in sufficient detail to warrant a separate report. The main effort of the summer 1966 season was devoted to field experiments for comparison with computer models of the microphysics and dynamics effects of seeding, exploratory work on the organization of mesoscale flows by seeding, precipitation results from massive seeding, and the development of advanced field techniques for large scale research and operational engineering studies of seeding. Case studies of some of the seeding events are described with some speculations based on the observations. Author

N68-17012# Travelers Research Center, Inc., Hartford, Conn.
FURTHER EXPERIMENTATION: STATISTICAL PREDICTION OF PRECIPITATION PROBABILITY Final Report
John A. Russo, Jr. Aug. 1967 41 p refs
(Contract CWB-11355)
(Rept.-7624-268; PB-175802) CFSTI: HC $3.00/MF $0.65

A number of experiments are performed in an attempt to: (1) improve the Regression Estimation of Event Probability (REEP) precipitation forecast equations developed in a previous study, (2) gain insight into potential improvement areas, and (3) assess the feasibility of extending the work to the prediction of quantitative precipitation amounts. Through the experimental work it is determined that the most promising area for improvement of the REEP prediction equations, for the shorter period forecasts, is through inclusion of a variable denoting existing conditions (persistence). A number of different forms of persistence are recommended for inclusion in future work (see Section 4.2). Other attempts at improvement of the prediction equations were not fruitful. Experimental work aimed at determination of the feasibility of extending this work to the prediction of quantitative precipitation amounts was promising upon generation of an all-precipitation sub-sample. Author

N68-17024*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
WIND VELOCITY PROFILES MEASURED BY THE SMOKE-TRAIL METHOD AT WALLOPS ISLAND, VIRGINIA, 1963 AND 1964
Robert M. Henry and Robert W. Miller Washington Mar. 1968 111 p refs
(NASA-TN-D-4365) CFSTI: HC $3.00/MF $0.65 CSCL 04B

Forty-five detailed profiles were obtained for heights from 0.5 to 30 km. Two second-stage profiles for heights from 39 to 58 km are also included. The profiles cover all seasons, and the

characteristics are generally similar to those of previously published smoke-trail profiles. Wind velocities in excess of the 99-percent extreme value are included. Closely spaced soundings show only small variations over horizontal distances of 2 km and time intervals of 1-1/2 hours. Author

N68-17026# Utah State Univ., Logan. Water Research Lab.
RELIABILITY OF CAN-TYPE PRECIPITATION GAGE MEASUREMENTS
C. Earl Israelsen Jul. 1967 77 p refs
(Contract DI-14-06-D-6003)
(TR-2; PB-175934) CFSTI: HC $3.00/MF $0.65

A comprehensive review of literature was made of studies conducted since 1952 pertaining to the accuracy of can-type precipitation gage measurements. Brief discussions are given of the results of some of them and conclusions are drawn. Topics discussed include raingage comparisons, accuracy of precipitation measurements, precipitation gage errors, and precipitation measurements in mountains. A bibliography is included. Author

N68-17060# St. Louis Univ., Mo. Dept. of Geophysics.
THE SYNOPTICS, DYNAMICS AND ENERGETICS OF THE TEMPORAL USING SATELLITE RADIATION DATA (IN ADDITION TO CONVENTIONAL OBSERVATIONS) Final Report
Albert J. Pallmann and Clifford J. Murino Jul. 1967 104 p refs
(Grant CWB-WBG-89)
(PB-175996) CFSTI: HC $3.00/MF $0.65

Presents the first year's scientific findings from research on the synoptics and dynamics of the temporal occurrence of 5–10 November 1963. Particular emphasis is placed on the 24-hour period centering on the time of maximum development of the storm, 7 November 1963. The research methodology involved the careful interlocking of the precise rectification of TIROS VII radiation data with conventional analyses of the thermodynamic and kinematic fields. Special care was taken of the upper air raw wind data by means of an appropriate smoothing technique. Recent investigations proved the combined Fourier-least squares approximation to be the most fitting method for determining representative wind profiles. Author

N68-17185# Stanford Research Inst., Menlo Park, Calif.
RELATIONSHIPS BETWEEN CIRCULATION PATTERNS AND SATELLITE-OBSERVED CLOUD COVER—CASE 2, APRIL 7–16, 1966
Eldon J. Wiegman, Rex G. Hadfield, and Sidney M. Serebreny Aug. 1967 62 p refs
(Contract CWB-11354)
(PB-176276; SR-2) CFSTI: HC $3.00/MF $0.65

This study was confined to the 10-day period April 7 through 16, 1966, using photographic data from the ESSA I satellite over the area 95W to 145W longitude and 15N to 40N latitude. The more significant circulation patterns encountered in this period included: (1) a series of fronts which moved through a high cell off the west coasts of the United States, (2) the evolution of a blocking anticyclone in the Eastern Pacific, (3) the dissipation of a trapped low south of this blocking anticyclone, (4) the southward migration of high cells on the east side of the Rockies and (5) the existence of subtropical jet streams through the lower latitudes of the Eastern Pacific and Mexico. The appearance and subsequent changes in the cloud patterns and/or circulation patterns are described. Those cloud patterns that seem of analytical value in delineating or detecting significant circulation patterns, or changes therein, are highlighted. Author

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N68-16243# Airborne Instruments Lab., Deer Park, N. Y.
SEAL CONTROL, DISPLAY AND RECORDING CONSOLE Final Report
J. P. Bethel Oct. 1967 111 p
(Contract FA65WA-1382)
(RD-67-22; AD-663180)

It is concluded that: (1) The console satisfies the design requirements set forth in the specification, as determined by factory acceptance tests. (2) The console is compatible with the SEAL (Signal Evaluation Airborne Laboratory) concept of flight inspection and will be useful in determining overall system performance. (3) The present console configuration approaches that of future production consoles. Fundamentally, however, it must be considered a tool for determining SEAL system performance and not necessarily the rigid prototype for future production consoles. In fact, this first console may include equipment and features beyond those required of production models and, conversely, may not include features that may later prove desirable. The modifications required can be determined after suitable flight-test experience. (4) The present DME and bearing-TACAN configuration will limit the utility of the SEAL system, due to the lack of a cross-check and back-up capability. Author (TAB)

N68-16387# Air Force Academy, Colo. Frank J. Seiler Research Lab.
TIME-OPTIMAL ATTITUDE CONTROL OF A SPINNING VEHICLE
Dirk H. de Does *In* Office of Aerospace Res. Proc. of the OAR Res. Appl. Conf., 14 Mar. 1967 Mar. 1967 p 227–235 refs
(See N68-16376 07-34)

The problem considered, a time-optimal control problem, is one of properly orienting a spinning vehicle with respect to specified reference directions, starting from known initial conditions of the vehicle's attitude and nutation rates. As a result: mathematical techniques for computing the time-optimal control law for a wide class of vehicles in which small changes in attitude are required were obtained; the influence of spin rate, vehicle geometry, control magnitude, and thrustor configuration on the time required to optimally reorient a spinning vehicle was demonstrated; and, true time-optimal solutions which may be useful in conjunction with feedback control, or as a reference in the evaluation of nearly time-optimal schemes were obtained. Author

N68-16437# Federal Aviation Agency, Atlantic City, N. J. Dept. of Transportation.
EVALUATION OF ECONOMICAL VISUAL APPROACH INDICATORS Final Report
D. Michael Brandewie Dec. 1967 42 p
(NA-67-13; RD-67-50)

An evaluation was conducted to determine the feasibility of a variety of "low-cost" visual approach slope techniques intended to aid pilots in establishing a suitable glide path prior to landing. The techniques included three-color and two-color types. Emphasis was placed on determining photometric characteristics, effects of humidity and temperature upon beam structure, and usefulness as seen in flight. They were compared in flight tests to a two-box

"abbreviated" version of the U. S. standard twelve-box visual approach slope indicator (VASI). Except for the two-box VASI, all could produce misleading and possibly hazardous information when condensation or ice formed on the glass face-plates, and none had a useful daytime range. Due to lack of boldness of presentation, all the three-color units were difficult to distinguish from runway edge and obstruction lighting. It was recommended that (1) tri-color techniques not be approved for operational use, (2) any technique which produces a false signal be excluded from the national airspace system, (3) investigations be continued to reduce cost to the standard and abbreviated VASI's, and (4) criteria be adopted for abbreviated VASI's. Author

N68-16486# Federal Aviation Agency, Washington, D. C. Navigation Development Div.

ADVANCED SCANNING BEAM GUIDANCE SYSTEM FOR ALL WEATHER LANDING Summary Report

Lawrence N. Spinner and Vincent L. Bencivenga Feb. 1968 42 p (RD-68-2)

A description and the test results of a development model of an advanced landing aid for all weather approach and landing are presented. The system operates in the microwave frequency region and provides precision azimuth and elevation guidance and range to touchdown to approaching aircraft. Also included in the system is a radar mode which operates as a primary radar to indicate aircraft position on a direct viewed storage tube. One cycle of the system operation occupies 200 miliseconds during which time Azimuth guidance, Elevation guidance, range function, and PAR mode are time shared and synchronized. The elevation antenna scans over an angle range 0 to 10 degrees and the azimuth scans from 5 degrees left to five degrees right of runway centerline. Clearance signals are provided to 35 degrees from runway centerline. Azimuth and elevation angles are resolved to increments of .01 degrees. A summary of the test data compiled is presented and recordings of the effects of interfering aircraft on the courses defined by the system are shown. It is concluded that the design objectives contained in the specification are met. Author

N68-16635*# Lockheed Electronics Co., Plainfield, N. J. Military Systems.

RESEARCH STUDY OF AN AIRCRAFT-CONTAINED RADAR ZERO–ZERO LANDING SYSTEM, VOLUME 1 Final Report, Jan.–Dec. 1967

David W. Young and James W. Suzansky Dec. 1967 143 p refs

(Contract NAS2-4091)

(NASA-CR-73184; Rept.-4, V. 1) CFSTI: HC $3.00/MF $0.65 CSCL 17G

Two rapid scan radar/display techniques (P^3I and CBRS) were developed and demonstrated, utilizing the benefits of each technique to provide a pictorial, vertical, linear perspective display of a landing area and the terrain preceding and surrounding it. The resulting display is intended for aircraft landings under conditions of zero visibility and zero ceiling without the need for cooperative ground equipment. An introduction to motion cue guidance is developed as a technique for designing radar, comparing radar/display results with normal vision, gaining insight into the experience of landing an aircraft, and drawing attention to the difficult task of visual landing as well as possible solutions for an instrument landing capability "better than visual". This report can be used as a concept design guide for low level flight, approach to landing, and touchdown. Author

N68-16744# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE DESIGN OF INERTIAL GUIDANCE SYSTEMS [K RASCHETU INERTSIAL'NOY NAVIGATSIONNOY SISTEMY]

N. Ya. Vovchenko 27 Jul. 1967 13 p refs Transl. into ENGLISH from Tr. Mosk. Aviats. Tekhnol. Inst. (Moscow), no. 161, 1965 p 76–85

(FTD-HT-23-573-67; AD-662841)

A geometric inertial navigation system with a gyrostabilized platform oriented in the horizontal plane is described. Equations of dynamics, introduced in an earlier work by V. A. Karakashev, are made more precise and an evaluation of the methodical errors arising from translational and Coriolis accelerations is presented. Numerical calculations indicate that these methodical errors are considerable but can be compensated for by the accurate measurement of the system parameters. Deriving the differential equations of the system from its kinematic block diagram simplifies their solution and allows one to evaluate the influences of separate dynamic elements in more comprehensive investigations by means of control theory methods. Author (TAB)

N68-16747*# Massachusetts Inst. of Tech., Cambridge. Experimental Astronomy Lab.

HYBRID DOPPLER-RADAR INERTIAL NAVIGATION TECHNIQUES FOR THE SUPERSONIC TRANSPORT AIRCRAFT

Frank Charles Sakran, Jr. (M.S. Thesis) Jun. 1967 60 p refs

(Grant NGR-22-009-229)

(NASA-CR-92985; TE-19) CFSTI: HC $3.00/MF $0.65 CSCL 17G

Two particular hybrid navigation systems utilizing both inertial and doppler radar sensors are studied for use in high speed aircraft such as the supersonic transport. The systems postulated consist of a semigeometric inertial system receiving linear velocity corrections from a Janus beam array doppler radar. System equations are linearized assuming constant aircraft velocity and quasistatic latitude. Response to constant component uncertainties of the two hybrid doppler–inertial systems is compared to that of a pure (undamped) inertial navigator. The predominant error sources are found to be either gyro drift or doppler radar bias propagating as a bounded oscillation in latitude and true heading, and unbounded in longitude. Author

N68-16748*# Massachusetts Inst. of Tech., Cambridge. Experimental Astronomy Lab.

STUDY OF AIRCRAFT POSITION FIXING USING THE NAVY NAVIGATIONAL SATELLITE SYSTEM

Benny R. Spicer (M.S. Thesis) May 1967 51 p refs

(Grant NGR-22-009-229)

(NASA-CR-92984; TE-18) CFSTI: HC $3.00/MF $0.65 CSCL 17G

The possibility of using the Navy Navigational Satellite System for position fixing of supersonic aircraft (speeds up to Mach 2.7) is examined. The effects of errors in required input data on the computed position of the aircraft are determined for various pass angles of the satellite with respect to the aircraft. Results indicate this system could be a valuable aid to supersonic aricraft navigation. Author

N68-16836*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

LUNAR MODULE PILOT CONTROL CONSIDERATIONS

Clarke T. Hackler, James R. Brickel, Herbert E. Smith, and Donald C. Cheatham Washington Feb. 1968 46 p refs

(NASA-TN-D-4131) CFSTI: HC $3.00/MF $0.65 CSCL 05H

The role of the pilot in control of the lunar module during the lunar landing mission is discussed. A brief description is given of the lunar module mission phases and the lunar module and its primary and backup guidance, navigation, and control sytems. The

pilot interfaces with the control system are also discussed. The various simulation studies and flight tests that have been conducted are reviewed. The reasons for the departure from a near-fuel-optimum trajectory and the several aspects of shaping the trajectory for visibility and other piloting considerations following this departure are analyzed. Finally, the primary areas of pilot control in the various phases are examined in detail and are related to such areas of concern as guidance monitoring, landing site inspection and change, landing, engine shutdown, terminal rendezvous, and docking. Author

N68-17001# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
RADAR OBSERVATION CONDITIONS OF POOR VISIBILITY
A. N. Rakhovetskiy 11 May 1967 86 p refs Transl. into ENGLISH from the book "Radiolokatsionnoye Nablyudeniye v Usloviyakh Plokhoy Vidimosti" (Moscow), Izd. Morsk. Transp., 1962 p 1–98
(FTD-MT-66-56; AD-663361)

Ship navigational radar is an effective means for revealing above-water objects in conditions of poor visibility. A radar image of the surrounding situation permits identifying the shore and determining the place of the vessel with respect to distances up to selected objects and with respect to their bearings. The booklet considers the following: the role of radar in the prevention of collisions; the free-space range of different objects; the effect of interference and false signals on the radar image; and also the organization and equipment of observations. With correct organization of a radar observation and with the competent operation of the set, radar is a reliable means of detection of encountered vessels in conditions of poor visibility, and the skillfull use of radar information permits preventing a dangerous approach of vessels. Author (TAB)

N68-17008*# Lockheed Electronics Co., Plainfield, N. J. Military Systems.
RESEARCH STUDY OF AN AIRCRAFT-CONTAINED RADAR ZERO–ZERO LANDING SYSTEM, VOLUME 2 Final Report, Jan.–Dec. 1967
David W. Young and James W. Suzansky Dec. 1967 68 p refs
(Contract NAS2-4091)
(NASA-CR-73185; Rept.-4, V. 2) CFSTI: HC $3.00/MF $0.65
CSCL 17G

Excerpts are presented from two reports, prepared in 1962 and 1965, on the concept of using long wave radar vision to produce a pictorial, linear perspective display, based on processed plan position indicator (P^3I) and cross beam raster scan (CBRS) techniques. This addendum and Volume 1 are intended as concept design guides for low level flight, specifically, approach to landing and touchdown. The 1965 report excerpts contain quotations from 14 references and comments on the use of the P^3I and CBRS certical display as examples of long wave vision. Requirements are discussed for resolution, attitude sensitivity, texture, beamwidth, and other parameters. The 1962 excerpts include data on: p^3I concept and circuitry, registration, nonambiguous interferometer techniques with largely spaced antennas, crossed beam comparisons to P^3I, and variable resolutions as a function of pilot eye movements. E.C.

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N68-16135# Iowa State Univ. of Science and Technology, Ames.
[REACTOR MATERIALS] Progress Report, Jul.–Sep. 1967
A. F. Voigt, ed. Sep. 1967 41 p refs
(IS-RD-11) CFSTI: HC $3.00/MF $0.65

A study was conducted of new and improved materials of interest in reactor development. Included in these materials are fuel and blanket metals, metals which have structural, container, or control properties of value in reactor design, and compounds and ceramics of potential use in reactors. The behavior of these materials during fabrication and the improvement in fabricability, the corrosion resistance of container metals to molten metal fuels and the nature of the attack of oxidizing atmospheres on refractory metals are topics which have direct application to reactor design. The availability of ultra-pure materials in the usual forms and as single crystals and the knowledge of the nature and amounts of residual impurities are important. Author (NASA)

N68-16142# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
MICROWAVE MEASUREMENT OF HIGH TEMPERATURES WITHIN NUCLEAR REACTORS Interim Report
T. R. Billeter and D. P. Brown Oct. 1967 25 p refs
(Contract AT(45-1)-1830)
(BNWL-399) CFSTI: HC $3.00/MF $0.65

Two microwave methods of measuring nuclear reactor in-core temperatures are proposed. Measurements by the first of the two methods investigated, the active system, are accomplished by relating the frequency shift of a microwave cavity to the temperature of its surroundings. In experimental tests, the measurement sensitivity of this method proved to be 300 kHz/°C for temperatures to 1000°C. Because the measurement of frequency to an accuracy of one part in 10^6 is possible with ease, a theoretical precision of measuring temperature is ±0.05°C. This is adequate to satisfy temperature sensor criteria of many recently constructed reactors. Response of the temperature sensor was not determined during the initial experiments; however, the sensor accurately monitored a rate-of-increase of temperature of 30°C/min. Stability of the required instrumentation proved excellent, and repeatability of measurements was only slightly affected by oxidation of the copper waveguide at the elevated temperature of 1000°C. Experimental work with the second method, a passive measurement system, requires employment of a microwave radiometer. Theoretical temperature sensitivity of the instrumentation indicates that a 1°C change at the sensor will provide a 0.45°C temperature change at the radiometer. Both temperature measurement methods require a waveguide to be inserted within a high-temperature and possibly corrosive environment. Methods which would retard the damaging effects of an oxidizing atmosphere are suggested in this report. Although preliminary in nature, experimental results indicate that microwave methods of monitoring nuclear reactor in-core temperatures during normal operation are adequately sensitive and should materially reduce problems associated with other types of temperature sensors. Author (NSA)

N68-16144# Atomics International, Canoga Park, Calif.
THE DISSASSEMBLY AND POSTOPERATION COMPONENT EXAMINATION OF THE SNAP 10A FS-3
J. P. Dooley and J. P. Beall 15 Sep. 1967 70 p refs
(Contract AT(04-3)-701)
(NAA-SR-12504) CFSTI: HC $3.00/MF $0.65

The SNAP 10A Flight System was operated as a gound demonstration test of the SNAP 10A system. After operating continuously for over 10,000 hr the test was terminated, the system was disassembled, and critical system components were examined to determine the effect of the system operating environment. The disassembly of the system and the postoperation examination of the system components, with the exception of the fuel, are described. Author (NSA)

N68-16176# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
DETERMINATION OF WIGNER DOSES IN GRAPHITE. NEUTRON SPECTRUM EFFECT [DETERMINATION DE DOSES WIGNER DANS LE GRAPHITE. EFFET DE SPECTRE NEUTRONIQUE]
Jean-Pierre Genthon Jun. 1967 36 p refs In FRENCH
(CEA-R-3226)

Various models representing the formation of Wigner defects are studied and compared. The Thompson–Wright model is chosen and this choice is justified. It is shown also that in the majority of cases of thermal neutron reactors, it is of no special use to know in detail the neutron spectrum to which the graphite is subjected, and that the Wigner dose W is given simply by a knowledge of the fast flux Φ_f (E>1 MeV) and of the flux per unit of lethargy at 1 keV, Φ measured using techniques which can today be applied in research reactors. W/Φ_f is a logarithmic function, given here. Author (NSA)

N68-16195# Massachusetts Inst. of Tech., Cambridge. Dept. of Nuclear Engineering.
USE OF EXPERIMENTS ON A SINGLE FUEL ELEMENT TO DETERMINE THE NUCLEAR PARAMETERS OF REACTOR LATTICES
Edward E. Pilat, M. J. Driscoll, I. Kaplan, and T. J. Thompson Feb. 1967 182 p refs
(Contract AT(30-1)-2344)
(MIT-2344-10; MITNE-81) CFSTI: HC $3.00/MF $0.65

The determination of lattice parameters by the Single Element Method (SEM) represents a desirable saving of time, money, effort, and material over their determination in critical or exponential experiments. It is shown that the method provides an excellent way of correlating the results of experimental measurements, since it shows what pertinent variables must be used to express the quantity of interest in a linear, or nearly linear, fashion. Values obtained by the SEM for the thermal utilization of lattices of uranium rods in heavy water are compared with THERMΦS calculations. Values of ρ_{28}, δ_{28}, and C* are obtained by the SEM for the same lattices. In addition the theoretical development of the SEM predicts that ρ_{28}, δ_{28}, C*, and δ_{25} should vary nearly linearly with the inverse of the unit cell volume. This explains the experimentally observed behavior and provides an important tool for the rational correlation of experimental results. Author (NSA)

N68-16209 Institutt for Atomenergi, Kjeller (Norway). Kjeller Research Establishment.
INTERPRETATION, ANALYSIS AND UTILIZATION OF REACTOR PHYSICS EXPERIMENTS IN THERMAL NEUTRON CRITICAL AND SUBCRITICAL ASSEMBLIES
Aug. 1966 141 p refs Presented at the 2nd NPY Intern. Advan. Summer School on Reactor Phys., Sandefjord, Norway, 22 Aug.–2 Sep. 1966; Sponsored by Intern. Atomic Energy Agency
(PB-175681) CFSTI: $3.00

CONTENTS:

1. THE BUCKLING CONCEPT IN REACTOR THEORY AND EXPERIMENT H. Kouts (Brookhaven Natl. Lab.) 13 p refs (See N68-16210 07-22)

2. EVALUATION OF BUCKLING AND OTHER PARAMETERS FROM TWO OR MULTIREGION EXPERIMENTS R. Persson (Aktiebolaget Atomenergie) 14 p refs (See N68-16211 07-22)

3. THE ANALYSIS OF CRITICAL AND SUBCRITICAL EXPERIMENTS, A COMPARISON I. Kaplan (MIT) 13 p refs (See N68-16212 07-22)

4. INTERPRETATION OF CRITICAL EXPERIMENTS WITH HETEROGENEOUS REACTOR THEORY S. M. Feinberg (I. Y. Kurchatov Inst. of Atomic Energy) 19 p refs (See N68-16213 07-22)

5. REVIEW OF EXPERIMENTAL TECHNIQUES FOR THE DETERMINATION OF CELL PARAMETERS I. Kaplan (MIT) 7 p refs (See N68-16214 07-22)

6. ANALYSIS AND UTILIZATION OF CELL PARAMETER MEASUREMENTS M. N. Nikolaev (Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii) 23 p refs (See N68-16215 07-22)

7. EXPERIMENTAL AND THEORETICAL DETERMINATION OF THERMAL AND EPITHERMAL NEUTRON SPECTRAL INDICES P. F. Zweifel (Mich. Univ.) 10 p refs (See N68-16216 07-22)

8. DEFINITION AND UTILIZATION OF THE CONCEPT OF REACTIVITY E. P. Gyftopoulos (MIT) 3 p refs (See N68-16217 07-22)

9. ANALYSIS AND UTILIZATION OF KINETIC EXPERIMENTS FOR DETERMINING REACTIVITY W. Matthes (European Atomic Energy Community) 37 p refs (See N68-16218 07-24)

10. THE INTERDEPENDENCE OF EXPERIMENTS AND THEORY IN REACTOR PHYSICS, WITH SPECIAL REFERENCE TO CURRENT OUTSTANDING PROBLEMS S. M. Feinberg (I. V. Kurchatov Inst. of Atomic Energy) 6 p (See N68-16219 07-22)

N68-16210 Brookhaven National Lab., Upton, N. Y.
THE BUCKLING CONCEPT IN REACTOR THEORY AND EXPERIMENT
H. Kouts *In* Inst. for Atomenergi Interpretation Anal. and Util. of Reactor Phys. Expt. in Thermal Neutron Critical and Subcritical Assemblies Aug. 1966 13 p refs (See N68-16209 07-22)

The concept of material buckling in reactor theory is discussed, starting from elementary monoenergetic diffusion theory. This is done by considering the nature of the solutions of the time-independent neutron balance equation for an infinite, homogeneous, isotropic, multiplying medium. At appropriate points, the generalization to heterogeneous or nonisotropic media is also discussed. It is found that the solution to the general equation, which admits both positive and negative flux densities, is equivalent to the solution of a certain eigenvalue equation. The principal eigenvalue of this equation is the buckling, and the associated eigenfunction leads to the most persistent form of the neutron flux. The concept of geometrical buckling is also considered. Turning to the experiments, material buckling is a useful characterization of the measurement of reproducing properties of a medium. Author

N68-16211 Aktiebolaget Atomenergi, Studsvik (Sweden).
EVALUATION OF BUCKLING AND OTHER PARAMETERS FROM TWO OR MULTIREGION EXPERIMENTS
R. Persson *In* Inst. for Atomenergi Interpretation, Anal. and Util. of Reactor Phys. Expt. in Thermal Neutron Critical and Subcritical Assemblies Aug. 1966 14 p refs (See N68-16209 07-22)

Methods of reducing the amount of fissile material needed for reactor physics experiments are discussed, with attention centered on the substitution technique in which a test region is introduced usually in successive steps. Buckling changes caused by substitution of fuel, coolant, etc. are the primary values measured and, depending on experimental conditions, evaluations may be made of material bucklings, diffusion coefficients, and anisotropy in neutron migration in the test region. Several techniques for analyzing substitution measurements are discussed such as the one-, two-, or multigroup theory combined with homogenized regions or heterogeneous (source–sink) methods. Use of the perturbation theory for an iterative solution is described; the fundamental idea is to normalize the theoretical data by means of the reference lattice and to determine the quantities wanted relative to those of the reference lattice. It is pointed out that uncertainties due to interaction effects between test and reference regions are suppressed by the successive-step technique. M.G.J.

N68-16212 Massachusetts Inst. of Tech., Cambridge.
THE ANALYSIS OF CRITICAL AND SUBCRITICAL EXPERIMENTS, A COMPARISON
I. Kaplan *In* Inst. for Atomenergi Interpretation, Anal. and Util. of Reactor Phys. Expt. in Thermal Neutron Critical and Subcritical Assemblies Aug. 1966 13 p refs (See N68-16209 07-22)

Consideration is given to some experimental methods and assemblies used to determine the nuclear parameters of heterogeneous thermal reactors. Information concerning these reactors is needed for the design and operation of reactors and to provide a firm basis for the development of calculational methods. This information is usually obtained in zero-power critical assemblies, exponential assemblies, miniature lattices, and from experiments involving a single fuel rod or a small number of rods. Methods are often used which involve only small amounts of the materials whose properties are sought. Questions arise as to whether the experiments made actually yield the information that is needed. The parameters of interest are discussed; some of the methods and assemblies used to determine them are considered; and some of the results obtained are discussed. Author

N68-16213 I. V. Kurchatov Inst. of Atomic Energy, Moscow (USSR).
INTERPRETATION OF CRITICAL EXPERIMENTS WITH HETEROGENEOUS REACTOR THEORY
S. M. Feinberg *In* Inst. for Atomenergi Interpretation, Anal. and Util. of Reactor Phys. Expt. in Thermal Neutron Critical and Subcritical Assemblies Aug. 1966 19 p refs (See N68-16209 07-22)

The basic principles of heterogeneous reactor theory are outlined. To bring out the essential features of the theory, a simplified physical system is considered consisting of line or point slugs in an infinite homogeneous moderator where diffusion theory is assumed to be valid. The critical condition and flux distribution for this system are derived. Some important results of the basic theory are discussed, such as verification of homogeneization processes, and calculations on nonuniform lattices and reactors containing a small number of slugs. The application of heterogeneous reactor theory for interpretation of experiments in critical assemblies is treated. The theory makes use of a number of parameters characterizing the fuel slugs and the moderator. Given a certain volume of experimental information, it is shown how to treat this information in order to derive values for the parameters. Methods for using the experimental information to assess the adequacy of the theory are suggested. The basic heterogeneous theory is further developed and generalized. The theory is developed in a multigroup formalism with many groups also in the thermal energy region. The effects of final slug size are discussed, taking into account nonuniform fission rate distributions and asymmetries of the neutron distribution in the vicinity of the slugs. Author

N68-16214 Massachusetts Inst. of Tech., Cambridge.
REVIEW OF EXPERIMENTAL TECHNIQUES FOR THE DETERMINATION OF CELL PARAMETERS
I. Kaplan *In* Inst. for Atomenergi Interpretation, Anal. and Util. of Reactor Phys. Expt. in Thermal Neutron Critical and Subcritical Assemblies Aug. 1966 p 7 refs (See N68-16209 07-22)

Some of the methods used for the measurement of cell parameters are discussed. The emphasis is on the physical ideas underlying the methods rather than on the details of the measurements, and on estimates of the uncertainties of the results. The main purpose is to provide a basis for the discussion of the problems involved in the improvement of the methods. Author

N68-16215 Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Obninsk (USSR).
ANALYSIS AND UTILIZATION OF CELL PARAMETER MEASUREMENTS
M. N. Nikolaev *In* Inst. for Atomenergi Interpretation, Anal. and Util. of Reactor Phys. Expt. in Thermal Neutron Critical and Subcritical Assemblies Aug. 1966 23 p refs (See N68-16209 07-22)

An analytical assessment is made of the degree to which existing methods and results of measurements of the thermal neutron heterogeneous system parameters meet requirements for experimental information. Ways of developing reactor physics experiments are considered from the viewpoint of applying the experiments for verifying the theory and calculational methods. The influence of apparatus effects on cell parameter measurements is discussed. Sources of cell parameter uncertainties are identified as those caused by use of cylindrical cell model with reflecting surface, and those connected with inaccuracies in cross sections. The importance of obtaining detailed experimental information about the neutron space-energy distribution is emphasized, with examples given of the thermal neutron, and fast neutron regions. The theory of describing the neutron diffusion in a lattice in terms of the cell parameters is considered, along with experiments for determining the symmetric and antisymmetric components of the neutron flux in a cell. M.G.J.

N68-16216 Michigan Univ., Ann Arbor.
EXPERIMENTAL AND THEORETICAL DETERMINATION OF THERMAL AND EPITHERMAL NEUTRON SPECTRAL INDICES
P. F. Zweifel *In* Inst. for Atomenergi Interpretation, Anal. and Util. of Reactor Phys. Expt. in Thermal Neutron Critical and Subcritical Assemblies Aug. 1966 10 p refs (See N68-16209 07-22)

Spectral indices are defined as integral quantities which give certain incomplete information regarding a neutron spectrum. They are important because they are, in general, quicker and easier to measure than the complete spectrum and can rapidly indicate calculational errors through comparison with the computed index. Emphasis is given to careful transport theoretical calculations of the indices. For thermal neutrons the Cd ratio and the determination of neutron temperature through foil activation are discussed. For epithermal neutrons, primary emphasis is given to resonance foil activation. Some remarks are also made concerning fast neutron indices, as measured through threshold reactions. In addition to the theoretical aspects, some general remarks are made concerning measurements. Author

N68-16217 Massachusetts Inst. of Tech., Cambridge.
DEFINITION AND UTILIZATION OF THE CONCEPT OF REACTIVITY
E. P. Gyftopoulos *In* Inst. for Atomenergi Interpretation, Anal. and Util. of Reactor Phys. Expt. in Thermal Neutron Critical and Subcritical Assemblies Aug. 1966 3 p refs (See N68-16209 07-22)

The analysis of the dynamic behavior of reactor systems is reviewed. The difficulties involved in carrying out exact analyses are discussed, and techniques for finding approximate answers are presented. The concept of reactivity is introduced as a result of one of these techniques. It is shown that the concept is well but arbitrarily defined. The usefulness and shortcomings of reactivity for the interpretation of dynamic experiments are reviewed. Several examples, illustrating either the advantages or the disadvantages of reactivity for experimental correlations, are given. Some thoughts for the consistent interpretation of experiments are outlined. Author

N68-16219 I. V. Kurchatov Inst. of Atomic Energy, Moscow (USSR).

THE INTERDEPENDENCE OF EXPERIMENTS AND THEORY IN REACTOR PHYSICS, WITH SPECIAL REFERENCE TO CURRENT OUTSTANDING PROBLEMS

S. M. Feinberg *In* Inst. for Atomenergi Interpretation, Anal. and Util. of Reactor Phys. Expt. in Thermal Neutron Critical and Subcritical Assemblies Aug. 1966 6 p (See N68-16209 07-22)

The necessity for the harmonious development of theory and experiment in the field of reactor physics is discussed. Viewed as promising is a reasonable combination of complex theoretical models and simple integral models based on a direct integral experiment, taking into account possible additional information on some differential parameters. The complex theoretical model is used to obtain the integral parameters on which the simple theoretical model is based; the latter is thoroughly verified on critical assemblies that considerably increase the reliability of the results. The accuracy that it is possible or desirable to require when reactor calculations are made is considered, and an example is given to illustrate how a reasonable engineering attitude to reactor design can eliminate the consequences of possible errors in physical calculations. Heterogeneous methods are reviewed, and their application to calculational practice and physical experiment is recommended. M.G.J.

N68-16222# Scottish Research Reactor Centre, East Kilbridge.

A MEASUREMENT OF THE TRANSFER FUNCTION OF THE UTR-100 REACTOR USING A REACTIVITY OSCILLATOR

J. Dickson and J. Scobie Aug. 1967 21 p

(SRRC-19/67)

Measurement of reactivity perturbations in the UTR-100 using a reactivity oscillator is detailed. The reacitvity oscillator and its associated instrumentation are described. An analysis of results is presented, and l/β calculations are shown graphically. NSA

N68-16226# Japan Atomic Energy Research Inst., Ibaraki.

ANALYSIS OF PHOTONEUTRON FLUX DISTRIBUTION IN WATER SHIELDED REACTORS

Takashi Tagami and Mitsuyuki Kitazume (Hitachi Ltd.) Dec. 1967 9 p refs Transl. into ENGLISH from J. Atomic Energy Soc. Japan, v. 8, no. 1, Jan. 1966 p 12–15

(NSJ-TR-93) Available from Div. of Tech. Inform., Japan Atomic Energy Res. Inst.

In a water-shielded reactor, the photonuclear reaction γ (d,p)n takes place between γ-rays emitted from reactor core and deuterons contained in the shielding water surrounding the core. Photoneutrons produced by the reaction are distributed in the water layer in addition to the neutrons originated from the core. It is shown that the distribution of the thermal photoneutron flux in water not close to the core surface is approximately given by a given simple formula based on the γ-ray flux in the i-th energy group and its linear absorption coefficient in water, the macroscopic cross section for the photoreaction, the diffusion coefficient and the absorption cross section for thermal neutrons in water and, is the slowing-down length in water. Comparison of the calculated results to the experiments in BSR-1 shows that the formula reproduces the photoneutron distribution reasonably well in a region where the neutron flux originated from the reactor core is negligibly small. In particular the expression for photoneutrons together with the calculated neutron flux originated from the core can explain a bend in the observed neutron flux distribution occurring at about 1.8 m from the core surface of BSR-1. Author

N68-16247# Oak Ridge National Lab., Tenn.

ON-LINE CALIBRATION OF HFIR CONTROL RODS USING THE ROD OSCILLATION TECHNIQUE

D. N. Fry 13 Sep. 1967 17 p refs

(Contract W-7405-ENG-26)

(ORNL-TM-1961) CFSTI: HC $3.00/MF $0.65

The digital computer at the HFIR will need accurate control rod calibration data to perform reactivity balance calculations. An evaluation of the rod oscillation method of measuring differential control rod worth is given. The oscillation method is especially attractive for on-line calibrations, because the measurement does not interrupt the normal operation of the reactor or alter the steady-state power level and, furthermore, it is relatively fast. The accuracy of rod worth obtained using the oscillation method was determined by comparing the results with rod bump-period measurements. The rod worths obtained using the two methods agreed to within 2%. Measurement of differential rod worth at one rod position required 20 sec using the oscillation method and approximately 2 min using the rod bump technique. Therefore, the rod oscillation method should provide accurate and fast on-line control rod calibration data for reactivity balance calculations at the HFIR. Author (NSA)

N68-16279# Case Inst. of Tech., Cleveland, Ohio.

THE HIGH POWER KINETICS OF A TWO-DIMENSIONAL CIRCULATING FUEL NUCLEAR REACTOR

Michael J. Kolar (Ph.D. Thesis) Jun. 1968 88 p refs

A two-dimensional model of a single channel circulating fuel reactor is used to investigate the effect of a radial temperature distribution on the neutron kinetics. A slug flow model with no delayed neutrons is used. The effects of a nonuniform radial heat source distribution and thermal conductivity are taken into account. The effect of the reactor wall temperature distribution on the kinetics is discussed. Author

N68-16296# Ente Nazionale per l'Energia Elettrica (Enel) Rome (Italy).

POWER DISTRIBUTION MEASUREMENT IN BOILING WATER REACTOR OF GARIGLIANO PLANT, INVOLVING GAMMA SCANNING OF FUEL ELEMENTS AT END OF 1B CYCLE Special Report No. 3

Roberto Bannella and Umberto Cammarota Aug. 1967 61 p refs

(Contract EURATOM-101-63-11RDI)

(EURAEC-1916; EUR-3398) CFSTI: HC $3.00/MF $0.65

Axial power distribution data for the Garigliano plant reactor are obtained during power operation by measuring neutron flux by irradiating probes which can be activated wires located in twenty core positions. Radial power distribution during plant operation is not determined experimentally, but is calculated by computer. When the reactor is shut down, experimental measurement is possible by γ scanning along the fuel elements. The γ scan measurements for the 1B fuel cycle are presented. Computed axial power distributions were also compared with measurements from wire irradiation. NSA

N68-16297# Kernforschungszentrum, Karlsruhe (West Germany).

PARAMETRIC STUDY OF THE DYNAMIC BEHAVIOUR AND STABILITY OF A STEAM-COOLED FAST REACTOR WITH AN INTEGRATED COOLING CYCLE

F. Erbacher, W. Frisch, W. Heubschmann, S. Malang, L. Ritz et al Oct. 1967 47 p refs Sponsored by Euratom

(EURFNR-406; EUR-3681.E; KFK-637) CFSTI: HC $3.00/MF $0.65

In a steam-cooled fast breeder reactor it is possible to produce inherent stability and safety from accidents by the feedback of the cooling cycle on the core. The effects of various parameters on stability and safety are determined for these disturbances: reactivity disturbance, blower failure, load changes, various pipe ruptures, and inadvertent fast unflooding. This results in trends and limits that should be observed in the design of the components and the arrangement of the cooling cycle. It is shown that in particular a cooling cycle integrated in a common pressure vessel produces easily inherent stability and safety of a steam-cooled fast reactor. Author (NSA)

N68-16298# Applicazioni e Ricerche Scientifiche, Milan (Italy).
[ON REACTOR COOLING] Quarterly Report, Apr. 1–Jun. 30, 1967
30 Jun. 1967 31 p refs
(Contract EURATOM-106-66-12-TEEI (RD))
(EURAEC-1912; EUR-3396; QR-5; TR-2) CFSTI: HC $3.00/MF $0.65

The vertical motion of a two-phase mixture in round ducts was analyzed under a dispersed annular motion and without heat exchange. Research on the thermal crisis with nonuniform thermal flux in simple geometries and with nonpositive input titres is presented. NSA

N68-16308# General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.
RADIAL VANE STEAM SEPARATOR DEVELOPMENT, PHASE 2 Quarterly Report, Nov. 1966–Jun. 1967
R. H. Moen Jul. 1967 57 p ref
(Contract AT(04-3)-189)
(GEAP-5524; EURAEC-1931; QR-8) CFSTI: HC $3.00/MF $0.65

The KRB radial vane separator design numbers were modified taking into account the operating data obtained during startup of the KRB reactor. Equations for flow and pressure drop throughout the separator were set up. Steady-state performance of KRB with the radial vane separator in place was predicted. The separator mechanical design was continually revised to reduce cost and manufacturing time; and the analysis of transient, safety, and licensing problems was begun. In addition, the natural frequency of the model separator (FCRV-4) in the Large Air–Water Test Facility in air and in water was measured, vibration of this unit during two-phase air–water flow was measured, the natural frequencies and vibration modes of the KRB reactor with the radial vane separator in place were predicted, and analysis of the vibration problem was begun. During the last week of the period planning for the model separator tests at reactor conditions in the new Large Steam–Water Test Facility were begun. Author (NSA)

N68-16316# General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.
TWO-PHASE FLOW STRUCTURE IN A NINE-ROD CHANNEL, STEAM-WATER AT 1000 psia Final Summary Report
E. Janssen Jun. 1967 85 p refs
(Contract AT(04-3)-189)
(GEAP-5480) CFSTI: HC $3.00/MF $0.65

Equipment was developed for making experimental determinations of the flow structure in a multirod test channel with steam-water at 1000 psia flow vertical upward. The instrumentation includes three isokinetic probes, three Preston shear probes, and porous wall segments on three of the rods: all of these instruments are located at the exit end of the heated length. A model was developed for interpreting the isokinetic data. For this model, ioskinetic conditions exist at $P^* = -0.275$. Calibration data for the shear probes fit the Preston tube calibration curve for single phase flow. Author (NSA)

N68-16366# Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik.
ECONOMIC ASPECTS OF NUCLEAR ENERGY PRODUCTION WITH DIFFERENT THERMAL AND FAST REACTORS AND THE REQUIRED SEPARATIVE WORK CAPABILITY
D. Gupta, W. Haefele, P. Jansen, and J. Seetzen Jun. 1967 24 p refs Sponsored in part by EURATOM
(KFK-566)

Several probable nuclear strategies, for a given nuclear energy growth curve, with different thermal converters, advanced converters and fast breeders with either Pu or U start-up, have been analyzed. The results indicate that the THTR type, would have some economic and raw material advantage over the LWR type, or a two type strategy with LWR and sodium cooled oxide breeder. However, the strategies with steam cooled oxide and Na cooled carbide breeders with ^{235}U startup show definite and significant cost and raw material advantage over any other strategies. Those breeders with U start-up represent their own particular type of converters which supply all of the Pu required by them, and with their introduction the importance of high breeding ratio gets considerably reduced. Although U start-up breeders require larger amounts of ^{235}U at the beginning, the total U consumption over a long period of time would be considerably lower than those with any other thermal or advanced converter systems. The results indicate further that the sodium cooled carbide breeders with ^{235}U start-up have the highest economic potential and the lowest U consumption of the reactor types considered. Author (NSA)

N68-16410# Applicazioni e Ricerche Scientifiche, Milan (Italy).
[ON REACTOR COOLING] Quarterly Report, 15 Dec. 1966–31 Mar. 1967
31 Mar. 1967 25 p
(Contract EURATOM-106-66-12-TEEI (RD))
(EURAEC-1873; EUR-3375; QR-4) CFSTI: HC $3.00/MF $0.65

Research on a correlation for the prediction of critical thermal flux under stationary conditions for round ducts and uniform heating is presented. Also, the theoretical study of the phenomenon of burnout crisis, from the hypothesis that one of the major effects causing this crisis is a phenomenon of non-equilibrium between diffusion and re-entrainment velocities, is described. NSA

N68-16411# AEG-Kernenergieanlagen, Frankfurt am Main (West Germany).
STABILITY TESTS ON BOILING WATER REACTORS Quarterly Report, 1 Apr.–30 Jun. 1967
Kraemer Schoeneberg 30 Jun. 1967 49 p
(Contract EURATOM-085-66-1 TEED)
(EURAEC-1899; EUR-3391; QR-10) CFSTI: HC $3.00/MF $0.65

The evaluation of the measurements made on the four-rod cluster is presented. The stationary measurements of the mixture density, which are significant both for the evaluation of the frequency response curve measurements and for the determination of certain constants of the theoretical model, are listed. In addition the results of various "Heating surface load–local steam bubble component" frequency response curve measurements were collocated. Compared with the measurements on the ring-gap geometry they show a lesser scattering and as a result of a denser series of readings a greater resolution. No essential differences can be detected between the results of the measurements on the ring-gap geometry and on the four-rod geometry. There is also a satisfactory agreement between the theoretically calculated frequency response curves and the experimentally obtained values which is comparable with the agreements obtained on the ring-gap geometry. The alterations to the regulation circuit of the velocity modulator and

especially the reconstruction of the semiductor were completed. Test runs showed that the plant is now ready for operations.
Author (NSA)

N68-16433# European Atomic Energy Community, Ispra (Italy).
SOME PROBLEMS OF STRESS WAVE PRODUCTION ENCOUNTERED IN THE STUDY OF PULSED FAST REACTOR DYNAMICS
J. Randles and R. Jaarsma Brussels Nov. 1967 48 p refs
(EUR-3654.E)

This paper considers two wave generation problems arising in pulsed fast reactor dynamics studies. The first porblem is that of the thermo-elastic response of the fuel element and cladding due to the rapid fuel temperature rise during a pulse. A theory describing this response for any form of fuel temperature input is given and then applied to the special case of (a) a discontinuous temperature rise and (b) a ramp rise in temperature. It is proved that, because of the short timescale of a pulse, the stresses developed in the fuel and cladding are insensitive to the detailed form of the temperature rise and can be calculated accurately by assuming a step function. The second problem considered in this paper is that of the ejection of the liquid metal coolant from the core of a pulsed fast reactor during the hypothetical collision of a broken fragment of the pulsation device. It is shown that the amplitude of core compression caused by this collision is strongly dependent on the transit time of acoustic waves (in the coolant) along the compressed length of core. The change in core volume is shown to satisfy a third order differential equation containing a delayed term, the delay being precisely the above transit time. This equation is solved numerically for a variety of conditions and the enhancement in the amplitude of core compression due to the ejection process is obtained over a wide range. Author

N68-16465# Idaho Nuclear Corp., Idaho Falls.
CHEMICAL TECHNOLOGY BRANCH ANNUAL REPORT, FISCAL YEAR 1967
J. R. Bower, ed. Oct. 1967 129 p refs
(Contract AT(10-1)-1230)
(IN-1087) CFSTI: HC $3.00/MF $0.65

Research progress is reported on: performance of ICPP fuel recovery processes, support studies for current ICPP fuel recovery processes, graphites fuel reprocessing, the Idaho waste calcining facility, advanced waste calcination studies, properties of solid calcined waste, heat transfer studies affecting the calcination process and storage of the calcined product, additional waste management studies, LOFT assistance program, other reactor technology support programs, and new modular pilot plant laboratories. NSA

N68-16478*# United Aircraft Corp., East Hartford, Conn.
EXPERIMENTAL INVESTIGATION OF FLOW PATTERNS IN RADIAL-OUTFLOW VORTEXES USING A ROTATING-PERIPHERAL-WALL WATER VORTEX TUBE
Arthur Travers Washington NASA Feb. 1968 68 p refs
(Contract NASw-847)
(NASA-CR-991; F-910091-10) CFSTI: HC $3.00/MF $0.65
CSCL 21F

Experiments were conducted to determine whether the turbulence observed in radial outflow vortices is caused by fluid injection at the peripheral wall or by an instability inherent with the flow of fluid radially outward from the centerline of the vortex, to determine criteria for the flow conditions that lead to turbulence, and to determine whether a rotating peripheral wall, a rotating inner porous tube, and rotating endwalls have significant effects on flow patterns. Results indicate that radial outflow vortices are characterized by turbulence with large eddies that convect fluid from the central region of the vortex to near the peripheral wall. These flow patterns exist for both basic and axial flow vortex configurations and for wide ranges of the flow conditions. Laminar flow was encountered only with low rates of radial outflow and low superimposed axial velocities. Rotation of the end walls affected flow patterns in the basic vortex configuration for a limited range of the flow conditions. Rotation of the inner porous tube had no effect. Rotation of the inner porous tube and end walls did not affect the flow patterns in the axial flow vortex configuration.
R.N.A.

N68-16493# Centre d'Etude de l'Energie Nucleaire, Mol (Belgium).
RESULTS OF SUBCRITICAL EXPERIMENTS CARRIED OUT ON 5% ENRICHED H_2O–UO_2 LATTICES [RESULTATS D'EXPERIENCES SOUS-CRITIQUES REALISEES SUR DES RESAUX H_2O–UO_2 ENRICHIS A 5%]
J. Debrue, L. Mewissen, F. Motte, J. Basselier (BelgoNucleaire), R. Delrue (BelgoNucleaire), et al Brussels EURATOM Dec. 1967 338 p refs In FRENCH; ENGLISH summary Prepared jointly with BelgoNucleaire
(Contract EURATOM-001-64-1 TRUB)
(EUR-3378.f; EURAEC-1882) CFSTI: HC $3.00/MF $0.65

This present document gives the results of all the different types of measurements carried out on subcritical assemblies using UO_2 with a 5% U-235 enrichement in the THETIS reactor at the Centre d'Etude de l'Energie Nucléaire (CEN) at Mol. The lattices studied were of the square pitch type and the H_2O/UO_2 ratio had successively the five following values: 1.51, 2.63, 4.13, 6.33 and 9.35. The maximum number of fuel elements available was 500, these having a useful length of 376.5 mm and a useful diameter of 7.6 mm. The cladding is steel (304) with a thickness of 0.2 mm. The following measuring techniques were used: the Inverse Multiplication Technique (IMT), the Source Ejection Technique (SET) and the Pulsed Neutrons Technique (PNT). A certain number of measurement results were selected in order to interpret the variation in the characteristics of the assemblies as a function of a determined variable (charging, "buckling", poisoning, etc.).
Author

N68-16533# Bettis Atomic Power Lab., Pittsburgh, Pa.
CONTINUUM DILATION MODEL FOR CREEP SWELLING OF CERAMIC NUCLEAR FUELS WITH APPLICATIONS (LWB-LSBR DEVELOPMENT PROGRAM)
N. C. Small Sep. 1967 44 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-649) CFSTI: HC $3.00/MF $0.65

A continuum model is presented for the creep swelling of ceramic nuclear fuel materials. The theory includes the effects of fabricated porosity, as well as fission induced porosity and surface tension. A central feature is the use of a macroscopic dilatational element in the form of a hollow sphere in which the central cavity plays the role of a large fabricated pore and the annulus contains fission gas pores which are, in turn, represented by analogous microscopic hollow spherical elements. For simplicity, one-dimensional strain is assumed and the resulting equations are applied to the densification and swelling of fuel plates as well as to the problem of sintering and hot pressing. Viscous behavior (creep exponent $n=1$) is assumed throughout the analysis except for the hot pressing example which is solved for an arbitrary n. The fuel plate problem is solved numerically by use of an IBM 7040 computer; an analytic solution is presented for sintering and a partially analytic approach is used for the hot pressing case. Several parametric studies are carried out for the fuel plate which show the effects of viscosity, initial fission pore spacing, and external (loop) pressure. A good correlation is obtained with existing ZrO_2–UO_2 plate swelling data. Author (NSA)

N68-16535# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
$^{147}PM_2O_3$ PROCESSING AND APPLICATION
R. J. Baker 15 Sep. 1967 14 p ref Presented at the 1967 Fall Meeting, Am. Ceram. Soc. Nucl. Div., Urbana, Ill., 19–22 Sep. 1967
(Contract AT(45-1)-1830)
(BNWL-SA-1309; CONF-670950-1) CFSTI: HC $3.00/MF $0.65

Aspects of $^{147}Pm_2O_3$ heat sources which are being considered in aerospace and terrestrial application are discussed, including the characteristics of promethium, Pm_2O_3 forming processes, and current applications. A 60 W heat source is described. NSA

N68-16536# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
EFFECTIVE SURFACE AREA OF FUEL CLUSTERS FOR RESONANCE INTEGRAL CALCULATIONS
M. J. Halsall Aug. 1967 31 p refs
(AECL-2775) Available from Atomic Energy of Canada, Ltd., Chalk River: $1.00

Measured resonance integrals and initial conversion ratios show a systematic dependence on coolant material which is not reproduced in LATREP calculations. Numerical factors affecting the calculation of the effective surface have been derived which to a large extent remove this discrepancy between measurement and calculation. These factors depend only on the coolant material. Normally resonance integrals for cluster fuel elements are defined only for the whole cluster. A method of apportioning this resonance integral among the various fuel rings in the cluster is described. For air and heavy water coolants the agreement with Hellstrand's measurements of resonance integrals is within the quoted experimental error. However, measurements with H_2O coolant seem to be low. Comparison of these calculation methods with measurements of initial conversion ratio in ZED-2 are more difficult. However, the comparison presented suggests that the calculated effective resonance integrals should be reduced by about 1 barn for all geometries and coolants. The calculation methods presented are straightforward and could be incorporated in the LATREP code without difficulty. Author (NSA)

N68-16541# General Electric Co., San Jose, Calif. Advanced Products Operation.
TERMINAL EXAMINATION AND EVALUATION OF EVESR MARK 3 ROD CLUSTER SUPERHEAT FUEL
S. A. Rabin Jun. 1967 68 p refs
(Contract AT(04-3)-189)
(GEAP-5481) CFSTI: HC $3.00/MF $0.65

The experimental fuel designated Mark III was irradiated as part of the EVESR Nuclear Superheat Fuel Development Program. The initial loading of this fuel in EVESR consisted of four bundles, each composed of four seven-rod clusters. Each bundle contained fuel rods having one cladding thickness—0.008, 0.012, 0.016, or 0.020 inch. Mark III fuel rods were 0.450-inch-diameter solid UO_2 pellets clad with Incoloy-800. The bundles were irradiated in the superheated steam environment for over 2 year and burnups to 9300 MWd/tU. Terminal examinations were performed on selected Mark III fuel elements. The examinations consisted of visual inspection, dimensional measurements, gamma scanning, fission gas release, burnup, fuel rod sectioning, metallography, and cladding mechanical property tests. Information was thus provided on the effects of design and operating conditions on fuel rod dimensional changes, mechanical integrity, and residual lifetime of the cladding, structural changes in Incoloy-800, general and localized in-pile corrosion of Incoloy-800, and effects of fuel rod spacers on corrosion and wear. No signs of fuel rod failure were evident (except for a bundle which had been undercooled. Author (NSA)

N68-16566# AEG-Kernenergieanlagen, Frankfurt am Main (West Germany).
STUDIES ON CYCLONES FOR STEAM SEPARATION IN BOILING WATER REACTORS Quarterly Report, Apr. 1–Jun. 30, 1967
18 Jul. 1967 37 p
(Contract EURATOM-083-66-1TEED)
(EURAEC-1900; EUR-3392; QR-6) CFSTI: HC $3.00/MF $0.65

The work accomplished consisted of mixture subdivision and on the required optimization of the dimensions of the single cyclone with the object to shift its ultimate load in the direction of higher throughput capacities. Theoretical considerations and the further evaluation of former steam tests were carried out. The work on the mixture subdivision dealt in detail with the problems which may arise through the separate forced guiding of the mixture for each row of cyclones and how they can be solved experimentally in the existing air/water test rig. In order to find out by which change of geometrical magnitudes of the individual cyclone a capacity increase can be obtained, the representations of the separating mechanism were studied in detail. The study was based on the steam tests in which pressure difference measurements at particularly interesting parts of the cyclone were carried out. Author (NSA)

N68-16574# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
FUEL ELEMENTS IN THE CORE OF THE REACTOR PEGASE: DESCRIPTION, SUCCESSIVE IMPROVEMENTS, ACTUAL POSSIBILITIES [LES ELEMENTS COMBUSTIBLES DUE COEUR DE LA PILE PEGASE; DESCRIPTION, AMELIORATIONS SUCCESSIVES, POSSIBILITIES PRESENTES]
Christian Desandre-Navarre, Bernard Lerouge, Jean-Pierre Schwartz Jul. 1967 62 p refs In FRENCH
(CEA-R-3213)

The core of the research reactor PEGASE, in operation at the Cadarache Nuclear Research Centre since 1963, contains fuel elements made from rolled plates of an Al-enriched U alloy whose characteristics have been changed several times. The modifications which have been made to these fuel elements are described with a view both to improving the technical qualities of the reactor and to decreasing its operational costs. Special attention is paid to the neutron aspects of the fuels, and, in particular, to the problem of the long-term modification of the reactivity. Author (NSA)

N68-16579# Mound Lab., Miamisburg, Ohio.
SUBCRITICAL NEUTRON MULTIPLICATION EXPERIMENT WITH SNAP-19C-2 HEAT SOURCES CONTAINING PLUTONIUM-238 ISOTOPE
R. A. Wolfe and D. A. Edling 23 Mar. 1967 12 p
(Contract AT(33-1)-Gen-53)
(MLM-1416(DEL-1)) CFSTI: HC $3.00/MF $0.65

Subcritical neutron multiplication determinations with seven SNAP 19C-2 heat sources containing plutonium-238 were performed at different array spacings in both an air and a water medium. The maximum neutron multiplication of 1.14 was obtained with seven SNAP 19C-2 heat sources completely water reflected in a 1/16-inch edge-to-edge planar array. The results from this experiment will provide information concerning the nuclear hazards associated with the future design of larger and more powerful heat sources containing plutonium-238. Author (NSA)

N68-16581# Idaho Nuclear Corp., Idaho Falls.
THE PENETRATION OF IODINE INTO PROTECTIVE COATINGS

R. R. Hammer, B. J. Newby, and K. L. Rhode Nov. 1967 9 p refs
(Contract AT(10-1)-1230)
(IN-1095) CFSTI: HC $3.00/MF $0.65

Of the radioactive isotopes which could be released to a reactor containment building as a result of certain nuclear reactor accidents, radioactive iodine is considered to be one of the greatest health hazards. The penetration of iodine into protective coatings characteristic of those used in reactor containment buildings has been studied. Penetration of iodine into the coating occurs with the paint coatings tested including epoxy, vinyl, chlorinated rubber, and phenolic. The penetration is at least in part reversible and the degree of penetration is associated with the temperature of the coating and its physical state. A model for unidirectional diffusion in a semi-infinite solid, derived from Fick's basic diffusion concepts, adequately describes the penetration of iodine into these coatings to thicknesses as great as 0.25 mm. Diffusivities for iodine (generated as I_2) in the protective coatings tested ranged from 10^{-8} to 10^{-10} cm^2-sec-1. Effects of coating type, additives, and exposure time are also reported. Author (NSA)

N68-16591# Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik.
GERMAN FAST BREEDER PROGRAM
W. Haefele Oct. 1967 15 p refs Presented at the Symp. on Fast Reactor Phys. and Related Safety Probl., Karlsruhe, Ger., 30 Oct.–3 Nov. 1967
(KFK-634; EURFNR-403; EUR-3678.E; CONF-671043-6) CFSTI: HC $3.00/MF $0.65

A description of the German fast breeder reactor program is presented. Experimental facilities described for the program include: pulsed subcritical SUAK assembly; STARK; fast zero power SNEAK; 20 MW(t) SEFOR test reactor; and KRITO thermal critical facility. NSA

N68-16607# Reactor Centrum Nederland, Petten.
THEORETICAL AND EXPERIMENTAL DETERMINATION OF THERMAL-NEUTRON GROUP CONSTANTS IN REGULAR LATTICES AND A PROGRAM DESCRIPTION OF THE CODE SATAN
Rudi J. J. Stamm'ler and Aldert Tas Apr. 1967 92 p refs
(RCN-62) CFSTI: HC $3.00/MF $0.65

Experimental methods, i.e. rolled wire, pin, extrapolation etc., giving information about the spatial variation of the neutron density, the neutron spectrum and the fission density inside the fuel of a unit cell are briefly discussed. It is found that for the selected cold, clean single pin lattices the differences between the best theoretical and experimental methods are small and fall in the range of numerical and experimental uncertainties. ESRO

N68-16629# Battelle Memorial Inst., Richland, Wash. Pacific Northwest Lab.
IRRADIATION BEHAVIOR OF ZIRCALOY-2 CLAD THORIUM–URANIUM–ZIRCONIUM FUEL ELEMENTS Interim Report
J. W. Goffard and R. K. Marshall Sep. 1967 29 p refs
(Contract AT(45-1)-1830)
(BNWL-479; IR-1) CFSTI: HC $3.00/MF $0.65

Seven tubular Th–2.5 wt % enriched U–1.0 wt % Zr alloy fuel elements are being irradiated under water cooled power reactor conditions. Irradiation performance of these Zircaloy-2 clad elements has been excellent to burnups of 2.1 at. % of the total atoms (18,600 MWd/t). Measured volume expansion of the alloy fuel has been at a rate approximately equal to that expected from the solid fission fragments. One element was destructively examined after an exposure of 1.4 at. % burnup (12,000 MWd/t). No evidence of fuel porosity was found, and little evidence of crystallographic damage was noted in the structure of the fuel. It is expected from existing data that the fuel will readily achieve 3.0 at. % burnup under water cooled power reactor conditions. Irradiation is continuing toward this goal exposure. Author (NSA)

N68-16664*# United Aircraft Corp., East Hartford, Conn. Research Labs.
INVESTIGATION OF GASEOUS NUCLEAR ROCKET TECHNOLOGY Quarterly Progress Report, 16 Sep.–15 Dec. 1967
G. H. McLafferty 30 Dec. 1967 27 p refs
(Contract NASw-847)
(NASA-CR-92987; F-910093-38; QPR-17) CFSTI: HC $3.00/MF $0.65 CSCL 21F

This investigation covers work in the following technical areas: (1) fuel retention characteristics of a model of a coaxial-flow gaseous nuclear rocket; (2) vortex flow, primarily in an RF-heated vortex, to obtain information for application to a nuclear light bulb reactor; (3) the opacity of seeds which might be employed in gaseous nuclear rockets; (4) in-reactor measurements of the transmission characteristics of transparent materials; and (5) studies of the effect of the results of these investigations on the characteristics of full-scale engines. In the coaxial-flow tests, experiments were conducted to determine the effect of buffer layer velocity and chamber length-to-diameter ratio on containment characteristics. RF vortex tests were conducted to determine the effect of various parameters on the radius of the gas discharge region. Refinements were made in the equipment for measuring gas opacity, including modifications necessary for determining the opacity of uranium gas. Additional tests of transparent materials in a TRIGA reactor were prepared. Author

N68-16689# Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik.
OPERATIONAL CHARACTERISTICS AND RELATED DESIGN FEATURES OF SNEAK
W. Bickel, P. Engelmann, H. Walze, and G. Wittek Oct. 1967 28 p refs Presented at the Symp. on Fast Reactor Phys. and Related Safety Probl., Karlsruhe, Germany, 30 Oct.–3 Nov. 1967
(KFK-632; EURFNR-401; EUR-3676.E; CONF-671043-4) CFSTI: HC $3.00/MF $0.65

A description of the fast zero power SNEAK reactor is presented. Details of instrumentation and control and the operational characteristics of the reactor are presented. NSA

N68-16712# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
AN ANALOG ITERATIVE MODEL FOR THE CALCULATION OF COOLANT DENSITY IN PRESSURE TUBE NUCLEAR BOILER CHANNELS
S. Petrarca 1967 30 p refs Presented at 5th Intern. Congr. of AICA, Lausanne, Switzerland, 28 Aug.–2 Sep. 1967
(RT/ING(67)16)

An analog iterative model for the calculation of the coolant density along the channel of a pressure-tube water boiling nuclear reactor is presented. We describe also a generator for the two-variable function $F(x,y) = x^y$, realized by standard elements of a PACE 231-R computer for the calculation of an empirical correlation between the quality and the density of the two-phase mixture. We briefly show how a slow analog computer (for example PACE 231-R) may be adapted to fast iterative computation. Calculations made by our model showed its accuracy to be excellent in large ranges of flow rate, pressure and heat flux. Author

N68-16742# Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik.
COMPARISON OF MEASUREMENTS IN SNEAK-1 AND ZPR 3-41
L. Barleon, R. Boehme, K. Boehnel, M. Edelmann, P. Engelmann et al Oct. 1967 34 p refs Presented at the Symp. on Fast Reactor Phys. and Related Safety Probl., Karlsruhe, West Ger., 30 Oct.–3 Nov. 1967 Sponsored by US-EURATOM
(EURFNR-395; EUR-3670.E; KFK-626; SM-101/8; CONF-671043-2) CFSTI: HC $3.00/MF $0.65

Data for critical mass measurements, prompt neutron decay constants, flux profiles, and fission ratios are presented and compared for the SNEAK-1 and the ZPR III-41 reactors. NSA

N68-16794# Aktiebolaget Atomenergi, Stockholm (Sweden).
IRRADIATION OF SUPERHEATER TEST FUEL ELEMENTS IN THE STEAM LOOP OF THE R2 REACTOR
F. Ravndal Dec. 1967 96 p refs
(AE-308)

The design, fabrication, irradiation results, and post-irradiation examination for three superheater test fuel elements are described. These clusters, each consisting of six fuel rods, were successfully exposed in the superheater loop No. 5 in the R2 reactor for a maximum of 24 days at a maximum outer cladding surface temperature of ≈650°C. During irradiation the linear heat rating of the rods was in the range 400–535 W/cm. The diameter of the UO_2 pellets was 11.5 and 13.0 mm; the wall thickness of the 20/25 Nb and 20/35 cladding was in every case 0.4 mm. The diametrical gap between fuel and cladding was one of the main parameters and was chosen to be 0.05, 0.07 and 0.10 mm. These experiments were carried out to demonstrate the operational capability of short superheater test fuel rods at steady and transient operational environments for the Marviken superheater fuel elements, and also to provide confirmation of design criteria for the same fuel elements. Author

N68-16817# Naval Research Lab., Washington, D. C.
FATIGUE CRACK PROPAGATION AND FRACTURE STUDIES OF A PRESSURE VESSEL STEEL TEMPER EMBRITTLED TO SIMULATE IRRADIATION DAMAGE
T. W. Crooker, L. A. Cooley, and E. A. Lange Oct. 1967 17 p refs
(NRL-MEMO-1822; AD-663133)

Fatigue crack propagation tests were conducted using plate bend specimens machined from shell material of the PM-2A half-scale model pressure vessel. The material is a Cr-Mo-V rotor steel, temper embrittled to represent the irradiated shell of the PM-2A reactor vessel. The fatigue tests were conducted in a room-air environment at 80 F, which is 160 F below the NDT (nil-ductility transition) temperature for this steel. Fatigue crack growth rates were correlated with total strain range, and were found to be similar to fatigue crack growth rates in other structural steels which possess comparable yield strength levels. Fracture occurred in the plate bend specimens of the test material during fatigue cycling. This represents a significant departure from the behavior of previously studied structural steels, and is attributed to the very high NDT temperature of the test material. An analysis of the fractures using an approximate solution for the stress-intensity factor, K, gave good agreement with previous plane strain fracture toughness measurements on the test material. Author (TAB)

N68-16831# Kernforschungszentrum, Karlsruhe (West Germany). Inst. Fuer Material- und Festkoerperforschung.
CENTRAL STATION FAST BREEDER REACTOR PLUTONIUM FUEL REQUIREMENTS
K. Kummerer Oct. 1967 15 p refs Presented at Symp. on Plutonium Fuels Tech., Nucl. Met. Comm. IMD-AIME, Phoenix, Ariz. 4–6 Oct. 1967 Prepared in Cooperation with EURATOM and Ges. Fuer Kernforschung mbH, Karlsruhe
(KFK-661; EUR-3697.E)

Some a basic decisions on fuel and fuel pin types are discussed in relation to the principal criteria for the fuel of large fast breeder reactors. These criteria comprise the questions of safety and economy and refer also to the applicable fabrication techniques. As the German development program pursues a sodium cooled fast breeder and a steam cooled version, the fuel pin requirements are compiled for both cases. A few very marked differences, especially the quite different external pressure load from the cooling medium, suggest a specifically adapted layout. The pin layout characteristics, proposed in detailed reference designs, translate the principal requirements to real designs and also to fuel and pin specifications. The basic ideas are discussed in the light of present knowledge and fabrication know-how. The realistic fabrication possibilities and the available experience on oxide pin performance lead to serious limitations, e.g. the radial swelling problem. The future development lines concerning fuel types and pin features are mentioned and compared to possible future fuel requirements. Author

N68-16832# Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.
FRACTURE MECHANICS EVALUATION OF REACTOR VESSEL STEELS Quarterly Progress Report, Period Ending Sep. 30, 1967
Oct. 1967 22 p refs
(Contract AT(30-1)-3677)
(WCAP-3677-5; EURAEC-1924) CFSTI: HC $3.00/MF $0.65

Irradiation conditions in the B and W Test Reactor for radiation damage studies on reactor vessel materials are given. Tensile, Charpy V-notch, and drop weight testing of the reactor vessel steels are discussed. Drop weight and tensile testing results are given. Results of Wedge Open Loading (WOL) tests are tabulated. NSA

N68-16875# Aktiebolaget Atomenergi, Stockholm (Sweden).
IFA-10, THE FIRST SWEDISH INSTRUMENTED FUEL ASSEMBLY IRRADIATED IN HBWR, NORWAY Final Report
J-A. Gyllander Dec. 1967 37 p refs
(AE-306)

Post-irradiation data are presented and correlated with irradiation statistics. No bowing of the bundle was observed, no equi-axed grain growth was discernible, the fission gas release was very small, and the relative dimensional changes in length and diameter were of the order of magnitude 9×10^{-4}. The hydride content of the can increased from 35 ppm to 65 ppm, and, in the contact point of the spacer, to 180 ppm. Author

N68-16880# Aktiebolaget Atomenergi, Stockholm (Sweden).
A STUDY OF THE ENERGY DEPENDENCE OF THE TH232 CAPTURE CROSS SECTION IN THE ENERGY REGION 0.1 TO 3.4 EV
G. Lundgren Nov. 1967 26 p refs Submitted for publication
(AE-304)

Using the fast chopper at the Stockholm reactor R1 a comparison between the (n,γ) cross sections for thorium and copper has been made in the energy interval 0.1 to 3.4 eV. The (n,γ) cross sections section for copper follows the 1/v law sufficiently well in this energy interval to be used as a 1/v standard. The deviation at 3.4 eV does not exceed 5%. The capture cross section, σ, for thorium decreases more rapidly than 1/v and the deviation

is found to be close to 60% at 3.4 eV. If one assumes that the deviation is caused essentially by a single negative resonance this should be located at 5.1±0.5 eV. Furthermore, if a value of 24 meV for Γ_γ, the radiation width for the negative resonance, is used one finds that Γ°_n, the reduced neutron width for the same resonance, amounts to 1.82±0.25 meV. Using these parameters together with the resonance parameters for the positive resonances a value of the total microscopic scattering cross section at 0.025 eV has been calculated as 12.2±0.4 b. A value of the contributions above 0.5 eV to the resonance integral from the "tail" of the negative resonance and the 1/v-parts of the positive resonances has also been calculated giving the result 1.6 b. Finally, the g-factor (Westcott's nomenclature) for a Maxwellian spectrum at 20°C becomes 0.994. Author

N68-16881# Aktiebolaget Atomenergi, Stockholm (Sweden).
STUDIES OF THE REACTIVITY EFFECT OF POLYTHENE IN THE FAST REACTOR FRO
L. I. Tiren and R. Hakansson Dec. 1967 25 p refs
(AE-305)

Measurements of the reactivity effect of polythene $(CH_2)_n$ have been made in two FRO assemblies having neutron spectra broadly similar to those of current steam cooled fast reactor concepts. The experiments include studies of the axial and radial distributions of the reactivity coefficient. The reactivity contributions from small polythene samples were found to be approximately additive. No large effects of heterogeneity or interaction between samples were observed. Comparisons with calculations using a homogeneous model are therefore relevant. The experimental results are largely in reasonable agreement with calculated values. The latter are very sensitive to moderate changes in the cross sections at low neutron energies. The agreement with experiment is improved if transport rather than diffusion theory is used. Although the geometrical size of FRO is probably adequate for studies of steam coefficients in fast power reactors, Pu isotopes and fission products should be included in the core composition in order to obtain information of direct use in such studies. Author

N68-16883# Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu.
SPACE AND ENERGY DISTRIBUTION OF THERMAL NEUTRONS IN A CYLINDRICAL HETEROGENEOUS REACTOR CELL [PROSTOROVE A ENERGETICKE ROZLOZENI TEPELNYCH NEUTRONU VE VALCOVE BUNCE HETEROGENNIHO REAKTORU]
M. Hron Aug. 1967 9 p refs In CZECHOSLOVAKIAN; ENGLISH summary
(UJV-1836)

The method for calculation of space and energy spectrum of thermal neutrons is extended to cylindrical geometry using a suitable approximation for calculation of the first flight collision probability. Results for heavy water cells with three types of fuel elements are mentioned. Author (NSA)

N68-16999# Kernforschungszentrum Karlsruhe (West Germany).
IRRADIATION PERFORMANCE OF FAST REACTOR FUELS
D. Geithoff, G. Karsten, and K. Kummerer Oct. 1967 27 p refs Presented at Symp. on Plutonium Fuels Tech., Nucl. Met. Comm. IMD-AIME, Phoenix, Ariz. 4–6 Oct. 1967 Prepared in cooperation with EURATOM and Ges. Fuer Kernforschung mbH., Karlsruhe
(KFK-662; EUR-3698.E)

Experimental and theoretical studies of the irradiation performance of fast reactor fuels, primarily uranium-plutonium dioxide fuels, are reported. The following conclusions are established: (1) With mixed oxide fuel a linear rod power of up to 500 W/cm maximum can be achieved without central melting. Also the burnup range of up to 100,000 MWd/t is a reasonable target; however, a careful adjustment of the internal fuel geometry is needed. (2) An additive to the fuel, such as molybdenum, improves the thermal conductivity to some extent. (3) According to the present state of fabrication technology, the pellet type oxide fuel has some preference compared to vibrocompacted powder fuel; however, irradiation results do not demonstrate any advantageous features for one or both competitors. (4) The short term behavior of the fuel (at startup or at power level changes of the reactor) appeared smooth and normal without any indication of undesired internal fuel movement. (5) The applied internal geometry parameters (low smeared density, gap width and dishing or non-dishing at pellets) were experimentally confirmed within the evaluated limited burnup range. S.C.W.

N68-17022*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL DETERMINATION OF GAMMA EXPOSURE RATE IN PLUM BROOK HB-6 FACILITY
John M. Bozek Washington Feb. 1968 14 p refs
(NASA-TM-X-1490) CFSTI: HC $3.00/MF $0.65 CSCL 18H

The gamma ray exposure rates in the HB-6 beam hole facility of the NASA Plum Brook Reactor were measured with lithium fluoride thermoluminescent dosimeters and argon-filled ion chambers. The exposure rates varied as a function of position in the test cavity and the time of measurement. To define and predict variations of the gamma exposure rate, an empirical relation between a standardized exposure rate and various reactor parameters was formulated. The standardized exposure rate, defined at 60 megawatts of reactor power, median values of reactor parameters, and the center of the radiation beam, were measured to be 7.6×10^4 roentgens per hour (19.6 (C/kg)/hr). Author

N68-17036# General Electric Co., San Jose, Calif. Advanced Products Operation.
DESIGN AND FABRICATION OF EVESR MARK 5 FUEL BUNDLES
C. E. Morris May 1967 99 p refs
(Contract AT(04-3)-189)
(GEAP-5408) CFSTI: HC $3.00/MF $0.65

The design and fabrication results of the EVESR Mark V fuel and bundle development program are described in this report. Four fuel bundles were designed to incorporate and test certain improvements over the previous seven-rod cluster designs which would be applicable for use in large superheat reactors. Features incorporated in Mark V include ribbed cladding turbulence promoters, lateral-type fuel rod spacers, thin thermal liners, and bimetallic process tube joints. The superheat fuel rods have various thicknesses of Incoloy and Inconel cladding over pellets or compacted powder fuel. Thermal-hydraulic analyses are presented which indicate the proposed fuel performance in EVESR through peak specific powers of 50 kW/kg of UO_2. Fabrication of fuel and bundle components was terminated short of final assembly into four bundles. However, many of the components, including fuel rods and subassemblies, were nearly completed for two of the bundles. Author (NSA)

N68-17037# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
THE CALCULATED PRODUCTION AND RELEASE RATE OF SEVERAL NUCLIDES FROM OXIDE FUEL ELEMENTS [CALCOLO DELLA PRODUZIONE E DELLA VELOCITA DI RILASCIO DI ALCUNI NUCLIDI DA UN ELEMENTO DI COMBUSTIBILE AD OSSIDO]

G. Cenacchi and G. J. Segre (Lab. Operazioni Calde, C.S.N., Rome) 1967 27 p refs In ITALIAN
(RT/FIMA-(67)2)

Production of Ba, Cs, I, Kr, Rb, Sr, Te, and Xe; and their release rate from UO_2 fuel elements is calculated for irradiation times of up to approximately five minutes. Author (NSA)

N68-17079# Oak Ridge National Lab., Tenn. Reactor Chemistry Div.
WATER CHEMISTRY IN PRESSURIZED AND BOILING WATER POWER REACTORS
C. H. Jenks and J. C. Griess Nov. 1967 55 p refs
(Contract W-7405-ENG-26)
(ORNL-4173) CFSTI: HC $3.00/MF $0.65

A literature survey of the corrosion behavior of materials in aqueous reactor environments as it relates to the need for water pruification and discussion of radiolytic gas generation and recombination in a boiling-water TLPR are presented. Author (NSA)

N68-17095*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SUMMARY OF RADIATION EFFECTS ON THERMIONIC INSULATOR MATERIALS
John T. Mayer Washington Feb. 1968 37 p refs
(NASA-TN-D-4414) CFSTI: HC $3.00/MF $0.65 CSCL 18J

Nuclear thermionic power systems are presently being studied for possible space applications. One of the critical materials in such designs is the metal oxide ceramic used as an electrical insulator and seal between various components. Such materials must withstand high temperatures (1000°C and above) as well as fast neutron doses to 10^{22} neutrons per square centimeter. To gain insight into their behavior in such an environment, a literature survey has been conducted for radiation effects data on the following candidates: beryllia, alumina, thoria, zirconia, and yttria. The properties of interest include dimensional changes, thermal and electrical conductivity, strength, thermal expansion coefficient, elastic modulus, and breakdown voltage. A large amount of data were found on beryllia, but much less work has been done on the other oxides, especially zirconia, thoria, and yttria. Beryllia seemed to be the most promising material, and its radiation stability may be improved by the use of additives and/or fine grained low density material. However, the large gas production rate in beryllia may restrict its use in thermionic systems; the release of a significant amount of helium gas into the interelectrode space may affect converter performance. The most successful tests on beryllia to date showed relatively minor changes after fast neutron doses to 9×10^{21} neutrons per square centimeter at 1000°C. In contrast, high temperature tests of alumina and yttria have resulted in gross fracturing at lower doses. No high temperature, high dose data on thoria or zirconia were found. Author

N68-17098*# Aerojet-General Corp., Sacramento, Calif.
GTR-16 RADIATION EFFECTS TEST ON STRUCTURAL MATERIALS AT −423°F: NERVA PROGRAM Final Report
W. Woleff, C. Dixon, J. Bauer, P. Dessau, and R. Matt Nov. 1966 197 p refs
(Contract SNP-1)
(NASA-CR-93135; TID-24148) CFSTI: HC $3.00/MF $0.65 CSCL 11F

Results are reported on the second radiation test on structural materials conducted for the NERVA Program. Detailed data pertaining to structural materials; ultimate and yield tensile strength, reduction of area, elongation, stress–strain curves, notched tensile strength, notched-to-unnotched strength ratio, and shear strength are included. Micrographs of representative specimens of each material in strained and unstrained region, as well as X-ray diffraction and electron fractographs are included. Radiation effects were evaluated by comparing the mechanical and metallurgical properties with and without radiation. All materials used were alloys and were irradiated and tested at liquid hydrogen environment without warm up. The average dose level obtained was 5×10^{16} nvt (E>1.0 MeV). Control and irradiated data for three types of bearing retainers are given. These retainers were made of Armalon containing FEP Teflon, or TFE Teflon. The irradiated specimens received a maximum integrated fast neutron exposure of $6>10^{16}$ nvt (E>1.0 MeV) and 1×10^{11} ergs/g(C) while immersed in LH_2. Both control and irradiated specimens were tested at room temperature. Author (NSA)

N68-17103# Atomic Energy of Canada, Ltd., Pinawa (Manitoba). Whiteshell Nuclear Research Establishment.
TECHNOLOGICAL PROGRESS IN CANADIAN NUCLEAR FUELS
R. G. Hart Aug. 1967 17 p refs Presented at the Nucl. Congr., Rome, 27–28 Jun. 1967
(AECL-2928; CONF-670639-1) CFSTI: HC $3.00/MF $0.65

A review of Canadian nuclear fuel development emphasizing the versatility of Zr alloy clad, UO_2 fuel arranged in short, multi-rod bundles is presented. Designs suitable for use in pressurized water, boiling water and organic liquid cooled systems are described. The developments leading to fuelling costs of 0.68 mills/kWh in the first Pickering electricity generating stations are discussed. The current status of Canadian development work on UC and U_3Si fuels is also reviewed. Author (NSA)

N68-17131*# United Aircraft Corp., East Hartford, Conn.
EXPLORATORY FLOW AND CONTAINMENT EXPERIMENTS IN A DIRECTED-WALL-JET VORTEX TUBE WITH RADIAL OUTFLOW AND MODERATE SUPERIMPOSED AXIAL FLOWS Fifth Interim Summary Technical Report, Sep. 15, 1965–May 30, 1967
Bruce V. Johnson Washington NASA Feb. 1968 85 p refs Sponsored in part by AEC
(Contract NASw-847)
(NASA-CR-992; F-910091-11) CFSTI: HC $3.00/MF $0.65 CSCL 21F

The containment characteristics of confined radial-outflow vortexes with superimposed axial flow were studied to determine whether high average simulated-fuel densities and high ratios of simulated propellant-to-fuel flow rates could be obtained. The experiments concentrated on two factors that influence simulated-fuel containment: (1) simulated-propellant injection methods in which the flow is injected from the peripheral wall of an axial-flow vortex tube with both axial and tangential (circumferential) components of velocity, and (2) simulated-fuel injection methods. Compared with the containment times measured with no axial component of injection velocity, improvements in containment time of as much as a factor of three-and-one-half were obtained in this investigation using injection with both axial and tangential components of velocity. However, the maximum containment times that were measured were approximately one to two orders of magnitude less than the value now estimated to be required for an economically practical, open-cycle gaseous-core nuclear rocket. Author

N68-17145# Mound Lab., Miamisburg, Ohio.
REACTOR FUELS AND MATERIALS DEVELOPMENT PLUTONIUM RESEARCH Annual Report, 1966
G. R. Grove 16 Oct. 1967 50 p refs
(Contract AT(33-1)-GEN-53)
(MLM-1402) CFSTI: HC $3.00/MF $0.65

Phase equilibria in the composition range $Pu–PuFe_2–PuMn_2$ were investigated. The effect of Zr additions on the phase equilibria of U–Pu alloys is being studied in the evaluation of potential fast breeder reactor fuels. The U–Zr and U–Pu binary systems were reviewed. From measurements of the internal friction and relative shear modulus during a phase change, the difference between a diffusional transformation and a shear transformation mechanism was determined. A simple, but sensitive, dilatometer was developed for the determination of solid state phase reactions. The heat capacities of the allotropes of Pu, including the liquid phase, were measured at 60 to 731°C. The measured liquid densities of two Pu–Ce alloys with 4.8 and 75 at. % Ce, respectively, agreed within ±0.6% with values calculated for ideal solutions of Pu and Ce. The liquid densities of four Pu–U alloys with 5.5, 10.8, 16.6 and 22.4 at. % U, respectively, were determined from near their liquidus temperatures to above 800°C. The viscosities of five Pu–U alloys with 5.5, 10.8, 16.6, 22.4 and 28.5 at. % U were measured from near their liquidus temperatures to nearly 800°C. Author (NSA)

N68-17153# Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik.
PHYSICS INVESTIGATIONS OF A 670 LITER STEAM COOLED FAST REACTOR SYSTEM IN SNEAK ASSEMBLY 3A-1
L. Barleon, A. Bayer, R. Boehme, K. Boehnel, K. Burkart et al Oct. 1967 45 p refs Presented at the Symp. on Fast Reactor Phys. and Related Safety Probl., Karlsruhe, West Ger., 30 Oct.–3 Nov. 1967 Sponsored by US–EURATOM
(EURFNR-396; EUR-3671.e; KFK-627; SM-101/11; CONF-671043-3) CFSTI: HC $3.00/MF $0.65

The critical experiment of SNEAK 3A-1, a 670 liter uranium system containing 7.41×10^{20} atoms/cm^3 of hydrogen in the form of polyethylene foils, has been started. The neutron physics of this assembly has been studied in detail. The neutron energy spectrum has been measured by various methods from the eV-region to over 1 MeV in the core center and at the periphery, reaction rates have been measured in the center and in axial and radial traverses, the initial breeding ratio and the reactivity worth of selected materials have been determined. Measurements of the Doppler reactivity effect, the steam void effect and of $\beta/1$ have been performed. Special effort was devoted to the experimental investigation of heterogeneity effects. The experimental results are compared with calculations using the 26 group ABN set and a specially prepared 26 group cross section set KFK-SNEAK using latest cross section information and the SNEAK-3A spectrum as a weighting spectrum. The heterogeneity results are compared with theoretical models including space dependent resonance self-shielding. Author (NSA)

N68-17184# United Kingdom Atomic Energy Authority, Risley (England). Reactor Group.
CALCULATION OF RELATIVE DISPLACEMENT DAMAGE RATES IN DIFFERING REACTOR TYPES
I. R. Birss 23 Aug. 1967 16 p refs
(TRG-1561(D)) CFSTI: HC $3.00/MF $0.65

Materials not necessarily destined for use in fast reactors, in which atomic displacements are the main damage mechanism under observation, are presently being irradiated in the Dounreay Fast Reactor. It is shown that, if it can be accepted that the ratio of atomic displacement rate in the test reactor to displacement rate in the parent reactor is an acceptable parameter for comparison purposes, then the atomic displacement energy and the electronic cut off energy of a material are not critical parameters in the derivation of this ratio. It is also shown that, if the equivalent fission flux concept is used to describe reactor spectra, it can lead to appreciable errors in deriving the damage ratio, but that integration over the real spectrum is unnecessary below about 0.1 MeV. Author

N68-17191# Atomics International, Canoga Park, Calif.
NUCLEAR SPACE POWER SYSTEMS
H. M. Dieckamp Sep. 1967 388 p refs
(AI-MEMO-7585)

Nuclear reactor and radioisotope space power systems are evaluated for their utilization in large boosters that have the capability of placing large vehicles and payloads into space. The applicable range of various power systems is outlined and their various advantages and disadvantages are described. It is concluded that as the power requirements increase to the order of tens of kilowatts a nuclear reactor system is the only one which seems feasible and has a favorable weight, size, and cost advantage over any of the presently envisioned solar power systems. G.G.

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N68-16156# Institut Franco-Allemand de Recherches, St. Louis (France).
MICROWAVE THERMOGRAPHY [MIKROWELLEN-THERMOGRAPHIE]
B. Koch and H. Oertel, Jr. 26 Oct. 1966 21 p refs In GERMAN
(ISL-T-25/66)

The optical fixation of radiative impact, especially of moving radiation fields, by microwave interference effects on thin evaporated film surfaces is described. The localized thermal impact produces a visible thickening in an oil film layer over a thin membrane with a bismuth shielding layer. Author

N68-16233# International Union of Pure and Applied Chemistry, Basle (Switzerland).
BIBLIOGRAPHY OF THE HIGH TEMPERATURE CHEMISTRY AND PHYSICS OF MATERIALS IN THE CONDENSED STATE
J. J. Diamond ed. (Natl. Bur. of Std., Washington, D. C.) Dec. 1967 87 p refs *Its* Vol. 1967, No. 4

A bibliography is presented of the report literature on devices, properties, phase equilibria, and reactions at high temperatures and in refractory materials. A short list of books on the subject is included. E.J.S.

N68-16275# Production Group, United Kingdom Atomic Energy Authority, Sellafield (England).
THE EXPERIMENTAL DETERMINATION OF THE PHOTOPEAK EFFICIENCIES OF NaI(Tl) DETECTORS FOR CYLINDRICAL GASEOUS SOURCES
V. Barnes and J. J. Wilson 1967 9 p refs
(PG-792(W)) CFSTI: HC $3.00/MF $0.65

A technique is described whereby the photopeak efficiency of a NaI(Tl) spectrometer for a gaseous source of a gamma-emitting isotope may be determined without reference to a standard gaseous source. The method makes use of calibrated solutions of radioactive isotopes which emit gamma photons of energy close to that of the radioactive gas to be measured. A knowledge of the abundance of the unconverted gamma photons emitted by the

calibrated solutions and by the gaseous isotope is also required. The underlying theory and the experimental details of the technique are described and also experiments to test the validity of results. Factors affecting the accuracy of the results are discussed and the variation of photopeak efficiency with photon energy is given for a 3 in.×2 in. diameter gaseous source resting on a 3 in.×3 in. NaI(Tl) crystal. Author (NSA)

N68-16335# Forsvarets Forskningsanstalt, Stockholm (Sweden).
POINTS OF VIEW ON THE EQUATION OF STATE OF URANIUM DIOXIDE [SYNPUNKTER PA TILLSTANDSEKVATIONEN FOER URANDIOXID]
N. Gyldén Sep. 1967 14 p refs In SWEDISH
(FOA-2-2496-44)

The equation of state of UO_2 is discussed for densities approximately equal to 10 g/cm^3 and at temperatures of about 2×10^4°K. The application of the principle of corresponding states and the Mie–Grueneisen equation of state for metals is compared. Since the density is 3 times greater than the critical density of UO_2 use of the corresponding state principle is doubtful. Instead the Mie–Grueneisen equation with regard to the melting process is recommended. NSA

N68-16406# Florida State Univ., Tallahassee.
RADIATION INDUCED LUMINESCENT PROCESSES IN GASES Progress Report
R. E. Glick and Russell J. Keirs 8 Dec. 1967 37 p
(Contract AT(40-1)-3349)
(ORO-3349-3) CFSTI: HC$3.00/MF$0.65

Experiments are reported describing luminescent processes resulting from 5-MeV-proton and 3-MeV-electron bombardment of gases at pressures from a few millimeters to several atmospheres. Luminescence does not appear to be traceable to direct transfer from the high-energy source to the system, but is induced by secondary electron processes. This is concluded from the fact that to the limit of quantitative comparison, identical luminescent features are found when either energetic particle is employed as the exciting source. Collisional titration of excited nitrogen species formed on irradiation of pure nitrogen provides additional confirmation of this conclusion. A device for scanning the luminescence profile in the neighborhood of a high-energy beam was recently constructed. Author (NSA)

N68-16423*# Yale Univ., New Haven, Conn. Dept. of Physics.
THE PHOTOELECTRIC EFFECT WITHOUT PHOTONS
Willis E. Lamb, Jr. and Marlan O. Scully (MIT) [1968] 14 p refs
(Grant NGR-07-004-035; Contract ARPA SD-90)
(NASA-CR-92701) CFSTI: HC$3.00/MF$0.65 CSCL 20J

The necessity of using electro magnetic field quantization to explain the photoelectric effect is questioned. A mathematical model is presented of a photodector with a collection of completely independent atoms. Each atom has one electron and is bathed in a classical electromagnetic field, for which the electric field is $E(t)=E_0 \cos \nu t$. The atom has a ground state $|g>$, and a quasi-continuum of excited states $|k>$ which are normalized in a length L very large compared to atomic dimensions, so that the k levels will approximate a continuum when L is eventually allowed to become infinite. Photoelectron emission involves a transition from $|g>$ to any of the $|k>$ states. Equation derivations are shown. It is concluded that the photoeffect is a result of a classified field falling on a quantized atomic electron; and the photon concept is neither logically implied nor necessary for its explanation. E.C.

N68-16431*# Cornell Aeronautical Lab., Inc., Buffalo, N. Y. Avionics Dept.
STUDY OF NONSTATIONARY RANDOM PROCESS THEORY
Walter W. Wierwille and James R. Knight Feb. 1968 61 p refs
(Contract NAS8-11346)
(NASA-CR-61190) CFSTI: HC$3.00/MF$0.65 CSCL 20A

This report deals with methods for analyzing nonstationary processes in nonreal-time (computer-time) applications. In many cases immediate read-out of a nonstationary statistical analysis is not required, and therefore more accurate off-line analysis may be performed. A theory for nonreal-time correlation analysis and a theory for nonreal-time spectrum analysis are presented. The theories are based on approximation of the expectation definition of the correlation function or its Fourier transform. Accordingly, correlation functions and spectra containing running-time axes may be postulated legitimately. The theories make use of test functions for optimization of the analyzer configurations. An experimental verification of the correlation theory is presented. Digital programs and plotting routines were used to obtain nonstationary correlation function estimates for data with known correlation functions, thereby making possible an analysis of estimation errors. A nonstationary correlation function estimate was obtained for flexible booster vibration data. This analysis shows the feasibility of the nonstationary theory. Author

N68-16462# National Bureau of Standards, Washington, D. C.
BIBLIOGRAPHY ON THE HIGH TEMPERATURE CHEMISTRY AND PHYSICS OF MATERIALS IN THE CONDENSED STATE
J. J. Diamond, ed. Sep. 1967 73 p refs *Its* Vol. 1967, No. 3
(NP-17141)

The 781 references included are grouped under the following section headings: devices for achieving temperatures above 1500°C; devices for measuring and controlling temperatures above 1500°C; devices for physical measurements at temperatures above 1000°C; properties, at temperatures below 1000°C, of materials which melt above 1500°C; properties, at temperatures above 1000°C, of materials which melt above 1500°C; properties, at temperatures above 1000°C, of materials which melt below 1500°C; phase equilibria; reactions at temperatures above 1000°C; and books. NSA

N68-16467# California Univ., Davis. Crocker Nuclear Lab.
DENSITY-MATRIX VARIATIONAL PRINCIPLES AT FINITE TEMPERATURES
Claude Garrod 14 Aug. 1967 9 p refs Presented at the Density Matrix Conf., Kingston, Canada, 1967
(Contract AT(11-1)-GEN-10)
(UCD-CNL-82; CONF-670828-1) CFSTI: HC$3.00/MF$0.65

Until very recently work done on variational principles involving reduced density matrices has been confined almost entirely to principles involving the ground-state properties of quantum systems. During the past year Kijewski and Percus have attacked the problem of extending the density matrix variational methods to systems at non-zero temperature by using the free-energy minimum principle. The work presented in this paper is a somewhat different approach to the same problem. NSA

N68-16556# Commonwealth Scientific and Industrial Research Organization, Sydney (Australia). Div. of Physics.
DIVISION OF PHYSICS ANNUAL REPORT, 1966–1967

1967 39 p refs
(NP-17117)

Brief summaries are given on research being carried out in the fields of temperature measurement, solid-state physics, fluid physics, optics, optical radiometry, solar physics, and resistance standards. NSA

N68-16686# Grumman Aircraft Engineering Corp., Bethpage N. Y. Geo-Astrophysics Section.
USE OF SUPERCONDUCTORS FOR GENERATION OF HIGH MAGNETIC FIELDS. PART 3: A PARTIALLY STABLE 90 KILOGAUSS COMPOSITE SUPERCONDUCTING SOLENOID
S. Lindenbaum and J. Becker Jan. 1968 21 p refs Presented at Conf. on Appl. Superconductivity, Austin, Tex., 6–8 Nov. 1967 Submitted for publication
(RE-318J)

A superconducting solenoid, composed of an outer coil of A-25 (Nb-25 atomic percent Zr) wound on an inner coil of T-48B (Nb-48 atomic percent Ti) was designed and constructed. The solenoid has a 1/2-inch bore, a length of 4.5 inches, and an outside diameter of 4.3 inches, and produces an axial field of 90 kilogauss with a maximum current of 25 amps (H/I = 3.6 kg/amp). The following relevant items are discussed: 1) a comparison of critical current and field with short length characteristics of T-48B; 2) techniques for achieving partial stability; 3) response of solenoid to training procedures; and 4) techniques for making superconducting-to-superconducting and superconducting-to-normal junctions, and a method for prevention of burnouts at these junctions. Author

N68-16671# Navy Underwater Sound Lab., New London, Conn.
NEW THEORETICAL EXPRESSIONS FOR PREDICTING SHIELDING EFFECTIVENESS FOR THE PLANE SHIELD CASE
Peter R. Bannister 7 Nov. 1967 22 p refs Submitted for publication
(USL-851; AD-663104)

The problem of the electromagnetic shielding effectiveness of a thin, plane metal sheet of infinite extent on an electromagnetic field generated by a circular loop field source with uniform current I is solved by application of the quasi-near and near-field approximations to the exact integral expressions. The results are shown to be in very good agreement with experimental data as well as numerical integration results. Also, they are very similar to the results obtained from the plane wave shielding theory of Schelkunoff. Author (TAB)

N68-16729*# National Bureau of Standards, Boulder, Colo. Inst. for Applied Technology.
ON THE PROBLEMS OF MEASURING TRANSIENT TEMPERATURE IN CRYOGENIC FLUIDS
C. E. Miller and T. M. Flynn Apr. 1967 6 p refs Repr. from ISA Trans., v. 6, no. 2, 1967 p 133–138
(NASA Order R-45)
(NASA-CR-92741; R-428; PB-175622) CFSTI: HC $3.00/MF $0.65 CSCL 20M

The complex and frequently unpredictable energy exchange mechanisms that govern the dynamic behavior of cryogenic sensors make the measurement of transient temperatures extremely difficult. Without suitable models by which to predict and evaluate sensor performance, considerable measurement errors can and do occur. The intent of the paper is to delineate in detail those factors which give rise to these errors. The validity of using notions based on the performance of the 'ideal' thermometer for characterizing the cryogenic case is also discussed. Author

N68-16776# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
SCREENING INFLUENCE ON THE NEGATIVE MASS EFFECT [VLIYANIE EKRANIROVKI NA EFFEKT OTRITSATEL'NOI MASSY]
I. N. Ivanov 1967 14 p refs In RUSSIAN
(JINR-P9-3476-2)

The effect of the conducting surface on the development of instability of the negative mass type was investigated for the case of infinite completely charged cylinders with azimuthal current, surrounded by metallic jacket. It was shown that the screening decreases the increments of growth of the instability. Author (NSA)

N68-16833# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
APPLICATIONS OF ULTRAHIGH VACUUM
Chung-i Hwa 17 Aug. 1967 17 p Transl. into ENGLISH from K'o Hsueh Hua Pao, No. 12, 1963 p 445–448
(FTD-HT-66-489; AD-663344)

This popularized article gives a general description of several ultrahigh vacuum devices on unusually clean surfaces. Cursory descriptions are given with diagrams of a condensation pump, which condenses either a liquid or solid, an ion pump with a limited evacuating power, a diffusion pump limited in attaining a very low pressure, an evacuation pump used to obtain ultrahigh vacuum, a rotating pump used to obtain high vacuum. Thermonuclear reactions are introduced to affect the potential low-pressure and high-purity gas. Ultrahigh vacuum has opened new avenues for the electron tube industry. TAB

N68-16924*# Michigan Univ., Ann Arbor.
OPTICAL PROCESSING TECHNIQUES Semiannual Status Report, 1 Mar.–31 Aug. 1967
Emmett N. Leith Dec. 1967 102 p refs
(Grant NGR-23-005-235)
(NASA-CR-92712; Rept.-8688-1-P) CSCL 20F

A theoretical study of holograms as visual displays considered present state-of-the-art and applications to training device, cockpit displays, and static displays. Other optical processing technique investigations dealt with the reduction of space-bandwidth product in holography, bleaching of photographically recorded interference patterns to improve diffraction efficiency, and propagation of optical signals through turbulent media. Diffraction efficiencies of about 45% were achieved during the study of various bleaches that convert optical density into corresponding changes in phase or index of refraction. A theoretical study of imaging through turbulent air has lead to a new method of approximate solution of the wave equation in turbulent media. Processing of received signals or images in real time or those recorded holographically are being investigated, as are optimum processors for specific situations. M.W.R.

N68-16935# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.
A TECHNIQUE FOR OBTAINING UNIFORM ASYMPTOTIC EXPANSIONS FROM BOUNDARY LAYER THEORY AS APPLIED TO DIFFRACTION PROBLEMS
E. Zauderer *In its* Microwave Res. Inst. Programs Nov. 1967 p 40–43 refs (See N68-16927 07-10)

Ray optical boundary layer expressions are used to derive uniform asymptotic expansions for diffraction problems of electromagnetic theory by forming the appropriate differential equations for various scattering problems. By stretching an

appropriate variable to measure distance, second derivative terms appear in the leading transport equation. Matching the boundary layer and the ray expansions in a region of common nobility leads to the determination of all unknown elements in the expansion, if the matching is carried out appropriately. G.G.

N68-16936# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.

GUIDED ELECTROMAGNETIC WAVES IN MOVING DISPERSIVE MEDIA

H. Berger and J. W. E. Griemsmann *In its* Microwave Res. Inst. Programs Nov. 1967 p 44–45 (See N68-16927 07-10)
(Contract Nonr-839(38))

This work deals with modal electromagnetic wave propagation in uniform, cross-section, perfectly conducting tubular waveguides filled with dispersive media in relative motion with respect to the waveguide walls. The treatment uses relativistic field-theoretic arguments based on Minkowski's phenomenological theory of electromagnetic fields in moving media. A greater richness and variety of phenomena are encountered in this study than in the comparable work for media at relative rest. In addition, clarification or corrections of several standard concepts and results of relativistic electromagnetics are brought out. Author

N68-16937# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.

THE POLARIZATION DEPENDENCE OF MICROWAVE BACKSCATTERING FROM SINUSOIDAL, CAPILLARY WAVES ON WATER

J. W. Ra and E. S. Cassedy *In its* Microwave Res. Inst. Programs Nov. 1967 p 45–49 refs (See N68-16927 07-10)

The backscattered electromagnetic fields from a sinusoidal interface to a dielectric medium are compared for two cases of horizontal polarization and vertical polarization by using perturbation theory to approximate the coefficients. A group of quantitative measurements is carried out for the first-order and second-order backscattering through an angular range of 10° to 50° (measured from the vertical normal). Microwave synchronous measurements of backscattered signals from a sinusoidal capillary-wave water surface show a measurable difference between the predicted value of first-order perturbation theory and experimental results. The quantitative difference amounts from 3 db to 5 db for first order backscattering, and to about 6 db for second order backscattering. G.G.

N68-16941# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.

LOW-FREQUENCY STIMULATED BRILLOUIN SCATTERING AND PHOTOELASTIC AMPLIFICATION

E. S. Cassedy and A. A. Oliner *In its* Microwave Res. Inst. Programs Nov. 1967 p 62–64 refs (See N68-16927 07-10)
(Contract AF 19(628)-4324)

A linearized model of parametric photoelastic interactions is formed for the coupling of small-signal light and elastic waves due to the presence of high intensity laser light. It is shown that the frequency and stability of the strong parametric interactions can be predicted by using the Brillouin diagram and the frequency relationships of parametric theory. Results show that stimulated Brillouin scattering occurs in the microwave range of a pump laser in the visible range; low frequency stimulated Brillouin scattering in anisotropic media is a backward-wave oscillation that dominates a backward-wave mixing interaction at the same frequency. A low frequency parametric photoelastic amplification in the UHF range is characterized as forward scatterer of the incident light. G.G.

N68-16946# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.

ANTI-CORRELATION EFFECTS IN QUANTUM OPTICS

P. P. Bertrand, A. Kestenbaum, M. M. Miller, E. A. Mishkin, and D. Stoler *In its* Microwave Res. Inst. Programs Nov. 1967 p 78–80 refs (See N68-16927 07-10)
(Contract N0014-67-A-0438-001)

Multi-mode fields are studied to determine pure, or mixed, states of the electromagnetic field that would display anti-correlation effects. Photon counting distribution and constant moments over the spectral bandwidth of the radiation field show that Fock states minimize correlation effects in fields with the same average number of photons in each mode; for fields with a continuous spectrum it is generally impossible to conclude whether they will display a correlation or an anti-correlation effect. G.G.

N68-16947# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.

WKB ENERGY EIGENVALUES OF THE SCHROEDINGER EQUATION

J. B. Krieger, M. L. Lewis, and C. Rosenzweig *In its* Microwave Res. Inst. Programs Nov. 1967 p 81–83 refs (See N68-16927 07-10)
(Grant NSF GY-752)

In order to estimate the accuracy of computed eigenvalues of the one-dimensional Schroedinger equation the first higher order corrections to the quantization integral are computed to see how much they change the first order result. Integration of the correction terms exactly, so that any discrepancy between the quantization calculated eigenvalues and the exact eigenvalues can be attributed to the method itself, show that both the second and third order integrals are zero for the linear harmonic oscillator. By employing higher correction terms almost arbitrarily accurate eigenvalues for large quantum numbers are obtained. The inclusion of a third order integral generally increases the reliability of the quantization eigenvalues; the accuracy is then better than 1% in all cases except the ground state. Author

N68-16949# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.

RESONANT MODES OF OPTIC CAVITIES OF SMALL FRESNEL NUMBERS: CIRCULAR RESONATORS

L. Bergstein and H. Schachter *In its* Microwave Res. Inst. Programs Nov. 1967 p 86–91 ref (See N68-16927 07-10)

A self-consistent perturbation method for optical cavities with circular resonators is developed by considering two identical circular parabolic reflectors of focal distance as an optical resonant cavity. The host medium between the reflectors is assumed to be linear, homogeneous, and isentropic and extends without limit in the transverse direction. Parabolic approximations are used to determine the electromagnetic field distribution over the reflecting surfaces. A perturbation method finds the eigenvalue and eigenfunction of a normal mode in a cavity of small Fresnel numbers by expansion in a power series. Plotting of the relative power losses of the four lower modes shows that effect of the reflector curvature. Author

N68-16969# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.

RAILROAD CAR DYNAMICS

R. F. Drenick and G. N. Sarma *In its* Microwave Res. Inst. Programs Nov. 1967 p 162–164 refs (See N68-16927 07-10)
(Contract DA-31-124-ARO(D)-307)

Presented is a mathematical model for analysis of the instability phenomenon that effects high speed railroad cars at high velocities. This linearized model for a railroad car running at constant speed on a level track decouples into two parts: one of which involves the longitudinal, vertical, and pitch movements, and the part that involves yaw, lateral, and roll movements. It is assumed that the latter part exhibits the above mentioned instability and can be simplified by stating that the car body's inertia is relatively large so that the trucks can be studied individually. Thus, the results of the resumption is a system with two degrees of freedom, yaw and lateral displacement of the truck. A study of this fourth order system shows that there is a critical velocity below which the system is stable above which the system is unstable. G.G.

N68-17041# Joint Publications Research Service, Washington, D. C.
FIBER OPTICS IN THE USSR
V. B. Veynberg 7 Feb. 1968 8 p refs Transl. into ENGLISH from Optiko-Mekh. Prom. (Leningrad), no. 11, 1967 p 48–51
(JPRS-44272) CFSTI: HC $3.00/MF $0.65

A brief survey sketches fiber optics research and development in the Soviet Union since 1958. Among the achievements cited are advances in light transmission and propagation techniques; fiber parts manufacturing processes; and image converter, lens, and recording and measuring instruments manufacture. E.C.

N68-17092# Defence Research Medical Labs., Toronto (Ontario).
IMPROVED DETECTABILITY OF SINUSOIDAL SIGNALS PRESENTED WITH 180° INTERAURAL PHASE DIFFERENCE
G. B. Henning and W. W. Demmery Aug. 1967 5 p refs
(DRET-TN-676)

The results are presented of both laboratory and field experiments on the effect of a difference in phase between the ears on the detection of a signal heard binaurally. The results show that with background noise in phase at the two ears, a sinusoidal signal presented with an interaural phase difference of 180° is detected at a much lower signal-to-noise ratio than when it is presented in phase. R.N.A.

N68-17118# Sandia Corp., Livermore, Calif.
MOMENTUM APPROACH FOR CALCULATING THE ATTENUATION OF PRESSURE PULSES IN DISTENDED MATERIALS
P. D. Anderson Oct. 1967 12 p
(Contract AT(29-1)-1789)
(SCL-DR-67-115) CFSTI: HC $3.00/MF $0.65

A simple method, based on momentum conservation, is developed for predicting the attenuation of thin pressure pulses in distended materials. Author (NSA)

N68-17119# Iowa State Univ. of Science and Technology, Ames.
A FORTRAN PROGRAM FOR THE CALCULATION OF DISLOCATION IMAGE PROFILES ACCORDING TO THE DYNAMICAL THEORY OF ELECTRON DIFFRACTION
H. J. Leamy and R. Trivedi Oct. 1967 18 p refs
(Contract W-7405-ENG-82)
(IS-1696) CFSTI: HC $3.00/MF $0.65

A FORTRAN program for calculation of the intensity distributions produced by dislocation arrays as observed by transmission electron microscopy under either bright or dark field conditions is presented. The programmed calculations are based upon the dynamical theory of electron diffraction in the two beam approximation. Author (NSA)

N68-17123# Atomic Energy Commission Research Establishment, Riso (Denmark).
INVESTIGATION OF THE DYNAMIC CHARACTERISTICS OF THE ELECTROMAGNETIC COUPLING BETWEEN MAGNET AND ABSORBER IN A FAST-RELEASING SAFETY ROD PLANNED FOR DR 3 [DYNAMIKUNDERSOEGELSE AF DEN ELEKTROMAGNETISKE KOBLING MELLEM MAGNET OF ABSORBER 1 DEN PLANLAGTE HURTIGUDLOESENDE SIKKERHEDSSTANG TIL DR 3]
Dan S. Nielsen Sep. 1967 30 p In DANISH
(RISO-M-627)

An analog model of the electromagnet for the planned fast-releasing safety rod for DR 3 was used for investigating the dynamics in the electromagnetic coupling upon interruption of the magnet current. Emphasis was placed on investigating the way in which air gap and eddy currents influence the magnet release time and the first part of the dropping curve of the absorber. Theoretical results are compared with measurements on an actual magnet. Author (NSA)

N68-17186# Cornell Univ., Ithaca, N. Y. Materials Science Center.
FAR INFRARED ABSORPTION IN KI-KBr MIXED CRYSTALS
Ralph Anton Westwig (M.S. Thesis) Jun. 1967 53 p refs
Sponsored in part by ARPA
(Contract AT(30-1)-2391)
(NYO-2391-64) CFSTI: HC $3.00/MF $0.65

Far-infrared absorption measurements have been made on KI-KBr mixed crystals. An impurity gap mode was located in low concentration $KI:Br^-$ at 73.8 cm^{-1}. Calculations were made using theoretical modes. A reduction of the impurity ion force constant was found necessary. Author

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N68-16110# Atomics International, Canoga Park, Calif.
LITHIUM HYDRIDE—HEAVY METAL SHIELDING EXPERIMENTS
A. W. Thiele 25 Apr. 1967 34 p refs
(NAA-SR-MEMO-12440) CFSTI: HC $3.00/MF $0.65

The attenuation of fission spectrum neutrons and gamma rays in slab shields composed of lithium hydride, uranium, and lead has been measured. The secondary gamma ray production and attenuation in the uranium and lead shields were determined. The neutron and gamma ray attenuation in laminated shields was also measured. A disc source and simple geometrical arrangements were used to minimize the uncertainty in the analytical interpretation. Author (NSA)

N68-16122# Argonne National Lab., Ill. Reactor Physics Div.
PROGRAMS FOR ANALYSIS OF SCATTERING ANGULAR DISTRIBUTIONS

E. M. Pennington, J. C. Gajniak, and R. A. Mewaldt. May 1967 71 p refs
(Contract W-31-109-ENG-38)
(ANL-7306) CFSTI: HC $3.00/MF $0.65

FORTRAN programs written to aid in the analysis of neutron elastic scattering angular distributions are described. The SAD program consists of subroutines used to obtain Legendre expansion coefficients by least-squares fitting of input angular data, to produce Calcomp plots of angular distribution data, to transform expansion coefficients from the laboratory system to the center-of-mass system, and to change the normalization of the expansion coefficients. Another program, DRIVER, plots expansion coefficients as a function of energy. Author (NSA)

N68-16168# Polish Academy of Sciences, Cracow. Inst. of Nuclear Physics.
APPLICATION OF THE SUM-COINCIDENCE METHOD FOR g-FACTOR MEASUREMENTS OF SHORT-LIVED EXCITED NUCLEAR STATES [ZASTOSOWANIE TECHNIKI KOINCYDENCJI SUM DO POMIAROW CZYNNIKOW g KROTKOZYCIOWYCH STANOW WZBUDZONYCH JADER]
Eugeniusz Bozek, Andrzej Z. Hrynkiewicz, Grzegorz Zapalski, Reinhard Kulessa, and Wladyslaw Walus. Sep. 1967 11 p refs Submitted for publication
(INP-569/PL)

The application of the sum-coincidence technique in g-factor measurements by the observation of the integral angular correlation perturbed in an oriented magnetic field is discussed. The described method was used for the determination of the g-factor of the 603 keV state in ^{124}Te. Author

N68-16170# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
PREPARATION OF ^{198}Au FREE FROM ^{199}Au [PREPARATION DE ^{198}Au EXEMPT DE ^{199}Au]
Andree Capgras. May 1967 9 p refs In FRENCH
(CEA-R-3239)

It was found that by irradiating ^{197}Au under a Cd cover in a neutron flux with a fast flux/thermal flux ratio of the order of 0.1, ^{198}Au containing less than 0.1% ^{199}Au could be obtained. NSA

N68-16175 United Kingdom Atomic Energy Authority, Harwell (England). Research Group.
FOIL MEASUREMENTS OF NEUTRON FLUX DISTRIBUTIONS AND SPECTRA IN IRON-WATER SHIELDS
J. Miyakoshi, S. Kawamoto, T. Yamada, K. Tanaka, and N. Kawamura. Feb. 1967 29 p refs Transl. into ENGLISH from Hitachi Zosen Giho, v. 27, no. 2, 1966 p 72-78

The neutron flux distribution and spectrum was measured along the central axis of the iron-water shields assembled in the HTR experimental pool. The fast and thermal neutron distribution are measured by means of a foil activation method. The threshold and resonance reactions were utilized to measure the fast and epithermal neutron spectrum. The removal and diffusion theory were employed with each iron-water configuration. A comparison of calculations with the two theories is presented. Author

N68-16188*# Naval Radiological Defense Lab., San Francisco, Calif.
CHARGED PARTICLE TRACKS IN POLYMERS NUMBER 6: A METHOD FOR CHARGE DETERMINATION OF HEAVY, MULTICHARGED COSMIC RAY PARTICLES
Eugene V. Benton and Richard P. Henke. 31 Oct. 1967 25 p refs
(NASA Order T-68092-G)
(NASA-CR-92750; USNRDL-TR-67-112; AD-660365) CFSTI: HC $3.00/MF $0.65 CSCL 20H

A simple, direct and accurate method for charge determination of heavy, multicharged cosmic ray particles is presented. The method is based on the measurement of the portion of the particle range over which a track can be produced by a heavy particle in plastics. Accuracy in Z of plus or minus 1 appears easily attainable. The results of a cellulose nitrate nuclear emulsion stack flown aboard a high altitude balloon are discussed. Author (TAB)

N68-16199# Los Alamos Scientific Lab., N. Mex.
THEORY OF A RADIOFREQUENCY SPIN FILTER FOR A METASTABLE HYDROGEN, DEUTERIUM, OR TRITIUM ATOMIC BEAM
Gerald G. Ohlsen and Joseph L. McKibben. Jul. 1967 58 p refs
(Contract W-7405-ENG-36)
(LA-3725) CFSTI: HC $3.00/MF $0.65

Techniques for selection of metastable hydrogen, deuterium, or tritium atoms with a particular nuclear spin polarization are discussed. The emphasis is on the three-level interaction technique, which promises to be the most versatile and satisfactory of those available. Author (NSA)

N68-16202# National Center for Radiological Health, Rockville, Md.
RADIONUCLIDE STANDARDIZATION
George I. Coats. Apr. 1967 42 p refs
(Contract PHS-999-RH-25)
(PB-176049) CFSTI: HC $3.00/MF $0.65

The bibliography contains references on absolute counting (23); coincidence technique, formula and corrections (41); calibration by beta and 4 pi beta methods (89), beta-gamma coincidence (32), gamma-gamma coincidence and gamma counting (27), X-ray-gamma coincidences (17), alpha-gamma coincidence (7), liquid scintillation counters (14), ion chambers and calorimeters (9), coincidence circuits (48); dead time and statistics (32); thin films (21); sample preparations, back scattering and self-absorption (30); maintenance and storage of standards (9); intercomparison of solutions (7); and general references (12). Author

N68-16203# Tokyo Univ. of Education (Japan). Dept. of Physics.
RELATIONS BETWEEN THE SPECTRA OF 2^+ AND 2^- MESONS
Chiaki Itoh [1967] 4 p refs
(TUEP-67-28)

Equations are derived to show the relations between the spectral functions of the symmetric tensor current and symmetric axial tensor current which couple to the 2^+ and 2^- mesons. Author

N68-16218 European Atomic Energy Community, Ispra (Italy).
ANALYSIS AND UTILIZATION OF KINETIC EXPERIMENTS FOR DETERMINING REACTIVITY
W. Matthes *In* Inst. for Atomenergi Interpretation, Anal. and Util. of Reactor Phys. Expt. in Thermal Neutron Critical and Subcritical Assemblies Aug. 1966 37 p refs (See N68-16209 07-22)

A freely decaying particle distribution in a stationary system can be represented as a superposition of exponentials. The amplitudes

and the decay constants may be calculated with an iteration procedure. This iteration will be started with the static eigenfunctions serving as a first approximation for the amplitudes. The usual inhour equation is just the first step in the iteration leading to improved values for the decay constants. The reactivity has therefore to be evaluated out of measured decay constants. The principles of existing methods for reactivity measurement are discussed within the constructed model using static eigenfunctions as approximations for the amplitudes and improved decay constants out of the inhour equation. Author

N68-16224 Tokyo Univ. of Education (Japan). Physics Dept.
THE SOFT MESON APPROXIMATION AND THE DECAYS OF TENSOR MESONS
Kimio Miura [1967] 4 p
(TUEP-67-27)

The soft pion approximation was used to calculate the decay rate of the ρ meson reported by Kawarabayashi and Suzuki. It is in reasonable agreement with experiment in spite of its large energy release. The observed partial decay widths of tensor mesons i.e., $A_2(1320)$, $K_2(1420)$, f(1250) and f'(1500) are compared with theoretical predictions based on the soft meson approximation, the nonet theory, and the PCAC hypothesis. By making use of the reduction technique, the PCAC hypothesis, and the soft meson approximation, an expression is obtained for the decays of the $J^P=2^+$ mesons into two pseudoscalar mesons. Author

N68-16249# Paris Univ., Orsay (France).
REPORT OF ACTIVITY, MAY 1966–MAY 1967 [RAPPORT D'ACTIVITE LER MAI 1966–LER MAI 1967]
Jun. 1967 53 p refs In FRENCH
(LAL-1176)

The improvement and utilization of the linear accelerator are summarized, together with research progress in nuclear physics, particle physics, storage rings, and the physics of bubble chambers. Development of associated experimental equipment and radiation control are reported. A bibliography of the publications during this period is appended. NSA

N68-16261# Cornell Univ., Ithaca, N. Y. Materials Science Center.
THE STARK EFFECT OF THE R CENTER IN KCl
Robert Gill McKinstry (M.S. Thesis) Sep. 1967 43 p refs Sponsored in part by ARPA
(Contract AT(30-1)-2150)
(NYO-2150-34) CFSTI: HC $3.00/MF $0.65

The theory of the Stark effect of the R center in KCl is presented. Experiments performed to measure the size of the splitting and to study the effects of temperature and polarization of the incident light are described. In general the results are in agreement with the current model of the R center. The matrix element $\langle E_x|x|E_x\rangle$ corresponding to the splitting was evaluated as 0.78×10^{-9} cm. NSA

N68-16284*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE INFLUENCE OF THE IONIZED MEDIUM ON SYNCHROTRON EMISSION OF INTERMEDIATE ENERGY ELECTRONS
Reuven Ramaty (NAS–NRC) Jan. 1968 35 p refs
(NASA-TM-X-63089; X-611-68-33) CFSTI: HC $3.00/MF $0.65
CSCL 20H

The suppression of synchrotron emission at low frequencies due to the influence of the ionized medium is investigated. Explicit expressions and detailed numerical values of the emission spectra are presented for various electron energies and plasma and cyclotron frequencies. Unlike previous studies of this suppression effect, which were applicable only to ultrarelativistic electrons, the present treatment is valid for electrons of arbitrary energies and in particular for intermediate energy electrons such as those presumably accelerated in solar flares. Author

N68-16305# Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu.
THE OPTICAL APPROXIMATION, PRIMARY RADIATION CHEMICAL YIELDS, AND STRUCTURE OF THE TRACK OF AN IONIZING PARTICLE
I. Santar and J. Bednar Aug. 1967 21 p refs
(UJV-1883)

Recent efforts in the theory of primary radiation chemical yields are summarized. Particular emphasis is put on the close connection between the approach used in this theory and the description of initial structure of the track of an ionizing particle. Author (NSA)

N68-16306# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.
TWO-DIMENSIONAL ANALYSIS OF THREE-BODY REACTIONS ^{11}B(p,$\alpha\alpha$) FROM 163 keV TO 2 MeV [ANALYSE BIPARAMETRIQUE DES REACTIONS A TROIS CORPS ^{11}B(p,$\alpha\alpha$) DE 163 KeV A 2 MeV]
Dieter Engelhardt and Jean Fontenille Jul. 1967 19 p refs In FRENCH
(CEA-R-3270)

An experimental apparatus for two-dimensional analysis of the breakup of $^{12}C^*$ produced by the reaction $^{11}B(p,\alpha\alpha)^4He$ at proton bombarding energies between 163 keV and 2 MeV is described. It uses Si surface-barrier detectors and fast–slow coincidence techniques: the energy resolution is about 40 keV and the time resolution is 6 nsec. A 4096-channel analyzer and a small digital computer was used for information storage and data processing. The experimental setup was tested on the CENG 2-MeV Van de Graaff accelerator. The spectra of the $^{12}C^*$ decay products taken at proton bombarding energies of 163 and 680 keV at different angles between the two α counters are shown. They indicate strong evidence for sequential decay of $^{12}C^*$ to the ^{8}Be fundamental, first, or second excited level. Author (NSA)

N68-16318# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science.
STUDY OF TWO-LEVEL INTERFERENCE IN NEUTRON CROSS SECTIONS
J. D. Garrison and R. A. Freeman (San Diego State Coll.) 1 Sep. 1967 227 p refs Supported in part by San Diego State Coll., Calif.
(GA-8203) CFSTI: HC $3.00/MF $0.65

Interference between resonances in neutron cross sections was studied using the two-level approximation. Sample cross sections indicating a wide variety of interference conditions were calculated and were plotted using the equations obtained from R-matrix theory. The mathematical connection between the R-matrix and the Kapur–Peierl theories provides two sets of resonance parameters for each cross-section calculation, allowing a numerical measure of the effects of interference. Statistical distributions of the Kapur–Peierl parameters for various interference conditions and the mathematical properties of the cross section when the resonance

widths are large compared to the spacing were also obtained.
Author (NSA)

N68-16325# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).
ABSORPTION MEASUREMENTS OF COPPER, SILVER, TIN, GOLD, AND BISMUTH IN THE FAR ULTRAVIOLET
R. Haensel, C. Kunz, T. Sasaki, and B. Sonntag Aug. 1967 23 p refs
(DESY-67/27)

Absorption measurements on copper, silver, tin, gold, and bismuth in the spectral range 50 to 340 Å were performed using the synchrotron radiation of the 6-GeV synchrotron DESY. The results are compared with previous measurements and theoretical predictions. A calculation of the partial oscillator sums from the available data gives rough agreement with the theoretically expected values.
Author (NSA)

N68-16333# Physikalisches Staatsinstitut, Hamburg (West Germany). Inst. fuer Experimentalphysik.
MONTE-CARLO CALCULATION FOR 3-GeV SHOWERS IN LEAD [MONTE-CARLO-RECHNUNG FUER 3 GeV-SCHAUER IN BLEI]
H. Burfeindt Jul. 1967 30 p refs In GERMAN
(DESY-67/24)

By means of a Monte Carlo program, parameters of electron–photon cascades in Pb were calculated for 3-GeV electrons as a primary particle. The results of the calculation were given in the form of energy, and longitudinal, radial, and angular distributions.
Author (NSA)

N68-16334# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science.
RADIATIVE CAPTURE CROSS SECTION MEASUREMENTS Summary Report, 1 Mar. 1966–28 Feb. 1967
W. M. Lopez, S. J. Friesenhahn, and F. H. Froehner 20 Feb. 1967 26 p refs
(Contract AT(04-3)-167)
(GA-7820) CFSTI: HC $3.00/MF $0.65

Neutron capture and total cross sections for ^{185}Re and ^{187}Re were measured, and resonance parameters were determined for 58 levels in the resolved resonance region of 1 to 100 eV. A resonance absorption integral of 820±50 b was calculated for normal Re from the results. Resonance parameters for ^{91}Zr were derived from neutron-capture data. Computer programs for the analysis of neutron resonance data were written. The use of neutron-capture data for the determination of the spins of energy levels was investigated; the technique was applied to three levels of ^{91}Zr. A 4000-liter liquid scintillator was modified, by optically decoupling the detector into two separate halves and requiring coincidence between the signals from the two halves, to operate in a coincidence mode that would reduce background count rates.
NSA

N68-16347# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
ENERGY SPECTRA OF LONG RANGE PARTICLES FROM THE THERMAL NEUTRON FISSION OF ^{235}U
M. Dakowski, J. Chwaszczewska, T. Krogulski, E. Piasecki, and M. Sowinski 1967 11 p refs
(INR-822/IA/PL)

Energy spectra of ^{1}H, ^{2}H, ^{3}H, ^{4}He, and ^{6}He from the thermal-neutron fission of ^{235}U were investigated using a semiconductor counter telescope and two-parameter analysis. Gaussian distributions were fitted to the measured distributions with the least squares method. Relative intensities were calculated.
Author (NSA)

N68-16348# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Obninsk (USSR). Fiziko-Energeticheskii Institut.
ANGULAR DISTRIBUTION OF FRAGMENTS OF PHOTOFISSION NEAR THE THRESHOLD [UGLOVOE RASPREDELINIE OSKOLKOV FOTODELENIYA VBLIZI POROGA]
N. S. Rabotnov, L. N. Smirenkin, A. S. Soldatov, L. N. Usachev, S. P. Kapitsa (Akad. Nauk SSSR, Moscow), et al 1966 7 p refs In RUSSIAN
(FEI-73)

The results of the measurement of the angular distribution of fission fragments of the nuclei ^{232}Th, ^{238}U, ^{240}Pu, and ^{242}Pu with γ quanta of bremsstrahlung in the energy interval from 5 to 8 MeV are reported. All expected consequence of the significant differences in the threshold between channels with different K were observed experimentally. The results supported the hypothesis of the existence of approximation laws on the conservation of the quantum number K under moderate excitation energy.
NSA

N68-16357# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
THE $\pi^- p \rightarrow \pi^- \pi^0 p$ INTERACTION AT 2.15 GeV/c [INTERACTIONS $\pi^- p \rightarrow \pi^- \pi^0 p$ A 2.15 GeV/c]
Jean-Pierre Baton Sep. 1967 22 p refs In FRENCH
(CEA-R-3291)

A study of the reaction $\pi^- p \rightarrow p\pi^-\pi^0$ for low values of the four momentum transferred to the proton was carried out with the 180 l liquid hydrogen bubble chamber exposed to a π^- beam of a 2.15 GeV/c. Production and decay properties of the $\rho^- \rightarrow \pi^-\pi^0$ meson are described.
Author (NSA)

N68-16360# Oak Ridge National Lab., Tenn. Neutron Physics Div.
CALCULATIONS OF THE EFFECT OF THE AIR–GROUND INTERFACE IN THE TRANSPORT OF FISSION NEUTRONS THROUGH THE ATMOSPHERE
E. A. Straker and F. R. Mynatt 1 Nov. 1967 21 p refs
(Contract W-7405-ENG-26; DASA Order E0-802-65; DASA Order E0-800-64)
(ORNL-TM-1819)

Two-dimensional discrete ordinates calculations of neutron transport in an air-over-ground geometry were performed for three different ground compositions. Results for a neutron fission source at 92 meters above the interface are compared with infinite air results. The calculated values of dose and thermal flux for both a fission and a Godiva leakage spectrum are compared with results from Operation BREN. Although the ground interface has a significant effect on the transport, the hydrogen content of the ground also has a large effect. Agreement between calculations and the BREN results is satisfactory when the Godiva leakage spectrum is used.
Author (NSA)

N68-16364# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
STUDY BY α-PARTICLE SCATTERING, OF THE COLLECTIVE STATES OF CLOSED SHELL NUCLEI WITH 28 NEUTRONS, 28 AND 50 PROTONS [ETUDE DES ETATS A CARACTERE COLLECTIF DES NOYAUX AU VOISINAGE DES COUCHES FERMEES PAR DIFFUSION INELASTIQUE DES PARTICULES α]
Gaston Bruge (Ph.D. Thesis—Paris Univ., Orsay, France) 27 Jan. 1967 90 p refs In FRENCH
(CEA-R-3142)

The results of a systematic study, by the inelastic scattering of 44-MeV alpha particles, of the collective states of nuclei near the closed shells with 28 neutrons and 28 and 50 protons are presented. The energy range corresponding to the two-phonon vibrational triplet was studied in detail. The nuclei considered were ^{52}Cr, ^{54}Fe, ^{56}Fe, ^{58}Fe, ^{58}Ni, ^{60}Ni, ^{62}Ni, ^{64}Ni, ^{112}Sn, ^{114}Sn, ^{116}Sn, ^{118}Sn, ^{120}Sn, ^{122}Sn, ^{124}Sn, ^{46}Ti, ^{48}Ti, and ^{50}Ti. The theoretical analysis was made with the Austern and Blair model using a phase-shift analysis of the elastic scattering. The deformation lengths and transition probabilities obtained are compared with other experimental and theoretical data. NSA

N68-16365# Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Kernphysik.

NUCLEAR STRUCTURE STUDIES WITH RADIATIVE NEUTRON CAPTURE

U. Fanger, G. Markus, W. Michaelis, H. Ottmar, and H. Schmidt Sep. 1967 8 p refs Presented at the Intern. Conf. on Nucl. Struct., Tokyo, 7–13 Sep. 1967
(KFK-616; CONF-670910-6)

The energy levels of ^{58}Fe and ^{62}Ni were investigated using the $^{57}Fe(n,\gamma)^{58}Fe$ and $^{61}Ni(n,\gamma)^{62}Ni$ reactions. Spin-party assignments were made for several levels of ^{58}Fe and ^{62}Ni, and level schemes were also proposed for the two nuclei. Gamma–gamma angular correlations in ^{88}Sr from the reaction $^{87}Sr(n,\gamma)^{88}Sr$ were measured; Legendre coefficients were determined as were spin-parity assignments for the initial states and possible shell-model configurations for these states. The level structure of the deformed nuclei ^{165}Dy, ^{167}Ev, and ^{169}Yb was also investigated using the capture technique. NSA

N68-16367# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).

CONSERVATION LAWS AND SELECTION RULES IN K-MESON DECAY

Henry Primakoff (Pennsylvania Univ.) Jun. 1967 53 p
(LPTHE-TH-204)

The discussion showed that the sum total of information on the decays of the K-mesons: is consistent with the CPT invariance of $H_{weak} + H_{elmag}$; is consistent with the CP invariance of $H_{weak} + H_{elmag}$ except for the presence of the K_2^0 decays is consistent with the $\Delta S = \Delta Q$ rule; exhibits violation of the $I = 1/2$ rule in the CP conserving decays $K^+ \rightarrow \pi^+ + \pi^0$ and K_1^0 decays which appear to be larger than might be reasonably expected on the basis of an electromagnetic origin of the violations; and exhibits relatively appreciable violations of the $\Delta I = 1/2$ rule in the CP violating K_2^0 decays however, the $\Delta I = 1/2$ rule violating matrix element in the CP conserving K_1^0 decays is large compared to the $\Delta I = 1/2$ rule violating matrix element in the CP-conserving K_2^0 decays. Author (NASA)

N68-16370*# National Bureau of Standards, Washington, D. C.

POLARONS IN ANISOTROPIC ENERGY BANDS

Arnold H. Kahn [1967] 13 p refs
(NASA Order R-09-022-033)
(NASA-CR-93001) CFSTI: HC $3.00/MF $0.65 CSCL 20H

The polaron weak coupling approximation has been applied to the problem of an electron on a spheroidal energy surface interacting with longitudinal optical phonons. The binding energy and effective masses are calculated. For $SrTiO_3$ where the observed masses are $m_l^*/m_e = 6.0$ and $m_t^*/m_e = 1.5$, the calculated bare masses are 4.7 and 0.96, respectively, and the binding energy is 0.26 eV. It is also shown how the polaron properties may be calculated when the band edge is of the degenerate type. Author

N68-16416# Illinois Univ., Urbana. Dept. of Physics.

SUM RULE CONSTRAINTS ON BARYON REGGE TRAJECTORIES

P. B. James 20 Dec. 1967 17 p refs
(Contract N00014-67-A-0305-0005)
(AD-663165)

Finite energy sum rules are used to study the residue function of the Baryon trajectory associated with the $Y1^*(1385)$ state. The results of this application of the sum rules are generally consistent with experiment, although there are certain inconsistencies which are attributed to approximations made in the calculation. Author (TAB)

N68-16422# Pittsburgh Univ., Pa.

HIGH ENERGY PHYSICS AT THE UNIVERSITY OF PITTSBURGH Progress Report, 1 Mar.–1 Dec. 1967

1 Dec. 1967 17 p refs
(Contract AT(30-1)-3829)
(NYO-3829-18) CFSTI: HC $3.00/MF $0.65

This research covers current algebra, the $\pi+\pi$ interaction in K_{e4} decay, fundamentals of quantum electrodynamics, quantum electrodynamical calculations in external fields, symmetry in classical systems, and the quark model. Also crossing matrices and relativistic Hamiltonian particle mechanics are discussed. NSA

N68-16435# Oak Ridge National Lab., Tenn. Neutron Physics Div.

EVALUATION OF NEUTRON CROSS SECTIONS FOR BORON-10

D. C. Irving 9 Oct. 1967 45 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1872) CFSTI: HC $3.00/MF $0.65

The neutron cross sections for ^{10}B were evaluated from 10^{-4} eV to 15 MeV. The existing experimental data are reviewed, and theoretical calculations and other reasoning are used to fill in the gaps. A complete and consistent set of cross sections is presented, and an explanation is given for the choices made in developing this cross-section set. Author (NSA)

N68-16436# Oak Ridge National Lab., Tenn. Neutron Physics Div.

DOSE RATE FROM HIGH-ENERGY ELECTRONS AND PHOTONS

R. G. Alsmiller, Jr. and H. S. Moran 20 Oct. 1967 11 p refs Submitted for publication
(Contract W-7405-ENG-26)
(ORNL-TM-2026) CFSTI: HC $3.00/MF $0.65

Electron-photon cascade calculations were carried out, and energy deposition as a function of depth was obtained for monoenergetic electrons (0.1 to 20 GeV) and photons (0.01 to 20 GeV) normally incident on a semi-infinite slab of water 30-cm thick. The calculated results are in approximate agreement with experimental data for the case of 5.2-GeV incident electrons. Author (NSA)

N68-16448# Tokyo Univ. (Japan). Dept. of Physics.

ALL THE HADRONIC CONTRIBUTIONS TO THE ANOMALOUS MAGNETIC MOMENT OF THE MUON AND THE LAMB SHIFT IN THE HYDROGEN ATOM

Hidezumi Terazawa Dec. 1967 13 p refs

All the hadronic contributions to the anomalous magnetic moment of the muon and the Lamb shift in the hydrogen atom were examined by the use of the identity, $(J_\mu{}^Y)_{\text{all hadrons}} = \lambda_\zeta \zeta_\mu + \lambda_\phi \phi_\mu + \lambda_\omega \omega_\mu$, proposed by Kroll, Lee, Zumino, and obtained the upper limits for them : $\Delta(1/2)\ (g_\mu - 2)_{\text{all hadrons}} < 2.2 \times 10^{-7}$ and $-(\Delta\mu)_{\text{all hadrons}} < 0.014$ Mc/sec $(2S_{1/2} - 2P_{1/2})$. Author

N68-16453# Oak Ridge National Lab., Tenn. Neutron Physics Div.

THE TRANSPORT OF 500-MeV/c MUONS IN IRON

M. Leimdorfer 7 Nov. 1967 13 p refs

(Contract W-7405-ENG-26)

(ORNL-TM-2048) CFSTI: HC $3.00/MF $0.65

Monte Carlo calculations of the slowing down of 500-MeV/c muons in iron cylinders are presented. The calculations include the effects of small-angle multiple-Coulomb scattering and range straggling. The results are compared with other calculations and experimental data. Author (NSA)

N68-16454# Technische Hochschule Hannover (West Germany). Arbeitsgruppe fuer Bautechnischen Strahlenschutz.

CALCULATION OF THE GROWTH FACTOR AND ALBEDO FACTOR WITH THE MONTE-CARLO PROGRAM GAMMONE [BERECHNUNG VON ZUWACHSFAKTOREN UND ALBEDO-FAKTOREN MIT DEM MONTE-CARLO PROGRAMM GAMMONE]

C. D. Wueneke Jan. 1967 32 p refs In GERMAN

(ABS-THH-1035)

The computer program GAMMONE utilizes the Monte Carlo technique in which the interaction process of γ radiation in the shield is simulated. The principle of the Monte Carlo method is outlined, and the stochastic methods used in the GAMMONE program are represented. The growth factors and albedo factors for γ radiation in layered shields were calculated, and the results are tabulated. NSA

N68-16481# Tokyo Univ. (Japan). Dept. of Physics.

TWO-DIMENSIONAL EUCLIDEAN GROUP AND THE PARTIAL WAVE EXPANSION, PART 1

Tadashi Miyazaki Dec. 1967 12 p refs

When the invariant amplitude f(s, t) is decomposed into the partial wave scattering amplitude for fixed t, four different cases are to be considered according to the values of t, and f(s, t) is considered as a function of a little group. In the case t=0, two cases occur and we treat the case that the little group becomes two-dimensional Euclidean group E_2. Then f(s, t=0) is taken as a function of E_2 and the partial wave expansion is formulated according to the unitary irreducible representations of E_2 and it is examined whether Regge behaviors can be picked up from this formulation. It is concluded that this group-theoretical method is very similar to the eikonal approximation representation. Author

N68-16488# RAND Corp., Santa Monica, Calif.

ENERGY-DEPENDENT NEUTRON TRANSPORT THEORY NEAR A TEMPERATURE DISCONTINUITY

Eugene C. Gritton and Anthony Leonard Dec. 1967 79 p refs

(Contract F44620-67-C-0045; Proj. RAND)

(RM-5300-PR; AD-663369)

An exact solution is obtained for the energy-dependent Boltzman transport equation for thermal neutrons near a temperature discontinuity. The medium is nonabsorbing and infinite in extent. The method of solution consists of expanding the energy-transfer kernel in a degenerate form and then solving directly for the solutions of the resulting homogeneous equation. Both discrete and singular solutions are found. The angular flux is then expanded in terms of a complete set of these solutions. Finally, the expansion coefficients are determined by applying the boundary conditions associated with the temperature-discontinuity problem. Numerical calculations of both scalar neutron flux and total neutron density are included for various temperature ratios and neutron-to-moderator mass ratios. A comparison of the transport-theory results with diffusion-theory results shows that diffusion theory describes the neutron flux quite accurately for small values of temperature discontinuity. Diffusion-theory calculations become less accurate, however, as the higher energy modes become important. Author (TAB)

N68-16495# California Univ., Davis. Crocker Nuclear Lab.

PROPERTIES OF THE 2-MATRIX DUE TO THE INTEGER CHARACTER OF OCCUPATION NUMBERS

Claude Garrod Aug. 1967 6 p Presented at the Density Matrix Conf., Kingston, Canada

(Contract AT(11-1)-GEN-10)

(UCD-CNL-83; CONF-670828-2)

The simple fact that the number of particles in any quantum state can only be an integer has nontrivial consequences for the properties of reduced density matrices. In this paper some of the simpler inequalities involving density-matrix elements which can be traced to the discreteness of the particles are investigated. NSA

N68-16498# Oak Ridge National Lab., Tenn. Reactor Div.

STUDY OF THE THREE-BODY PROBLEM IN QUANTUM MECHANICS

J. H. Marable (Ph.D. Thesis—Tenn. Univ., Knoxville) Nov. 1967 137 p refs

(Contract W-7405-ENG-26)

(ORNL-TM-2008) CFSTI: HC $3.00/MF $0.65

The purpose of the study was to develop general methods for the calculation of quantum-mechanical three-body problems. In particular, methods are needed to calculate wave functions of bound systems and scattering systems in which the form of the potential is as general as possible. The method developed has been shown to give good results for the bound state of the helium atom. Particular systems for which this method appears to be especially useful are the scattering of nucleons by deuterons, direct reactions involving deuterons, and nuclear reactions involving three-body final states. NSA

N68-16499# Brookhaven National Lab., Upton, N. Y.

NUCLEAR MAGNETIC AND ELECTRIC MOMENTS

Victor W. Cohen 14 Sep. 1967 21 p refs Presented at German Phys. Soc., Berlin Sponsored by AEC

(BNL-11746; CONF-671042-1) CFSTI: HC $3.00/MF $0.65

A brief review of the interactions and measurement of nuclear moments is presented. The nuclear quantities that can be determined using optical double resonance, paramagnetic resonance, nuclear magnetic resonance, optical hyperfine structure, and particularly, atomic beam magnetic resonance are discussed. Experiments for determining the electric dipole moments of the Cs atom and the neutron are also outlined. NSA

N68-16500# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
SEPARATION OF REACTION MECHANISMS AT LOW ENERGY. STUDY OF THE REACTION: $^{27}Al(d,p)^{28}Al$, $^{24}Mg(d,p)^{25}Mg$, AND $^{24}Mg(d,\alpha)^{22}Na$ [SUR LA SEPARATION DES MECANISMES DE REACTION A BASSE ENERGIE. ETUDE DES REACTIONS: $^{27}Al(d,p)^{28}Al$, $^{24}Mg(d,p)^{25}Mg$ ET
Michel Mermaz (Ph.D. Thesis—Paris Univ., France) 28 Jun. 1966 112 p refs In FRENCH
(CEA-R-3078)

The two sets of angular distributions of (d,p) reactions on Al and Mg, measured between 2 and 6 MeV, have given the possibility of testing, in analyzing the statistical fluctuations of cross sections, the validity of the separation of their mean values into two parts: a direct part and another part given by the statistical mechanism. With the same method of analysis, excitation functions for several alpha groups of the reaction $^{24}Mg(d,\alpha)^{22}Na$ were studied, and evidence was obtained for an intermediate structure for the alpha channel leading to the third excited state of ^{22}Na. The angular distribution of the wide resonance at 15.9 MeV in ^{26}Al was obtained. Author (NSA)

N68-16511# Brookhaven National Lab., Upton, N. Y.
PROTON–NUCLEI REACTIONS AT 1 GeV INCIDENT ENERGY
J. L. Friedes 30 Oct. 1967 28 p refs Presented at 1967 Meeting of the Nucl. Phys. Div. of the Am. Phys. Soc., Madison, Wis., 25 Oct. 1967
(BNL-11890; CONF-671040-2) CFSTI: HC $3.00/MF $0.65

The relation between nuclear structure studies from high-energy electron scattering experiments with data from 1-GeV proton–nuclei elastic scattering is investigated by proton scattering from helium-4, oxygen-16, and carbon-12 at 1 GeV. The resulting behavior of the cross sections is shown. It is found that results from the Glauber theory are encouraging. NSA

N68-16512# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
SINGULAR EXTRINSIC SOLUTION FOR THE STATIC ELECTRIC AND MAGNETIC DIPOLES IN THE THEORY OF GRAVITATION [OB ODNOM VNESHNEM RESHENII DLYA STATICHESKIKH ELEKTRICHESKOGO I MAGNITNOGO DIPOLEI V TEORII TYAGOTENIYA]
R. A. Asanov 1967 7 p refs In RUSSIAN
(JINR-P2-3485)

Fisher and Tauber present exact static solutions of the Einstein and Maxwell equation for electric and magnetic dipoles. These solutions have the form: $\exp(\alpha) = \exp(\beta) = \exp(-\gamma) = 1 - p\sqrt{\kappa}\cos\theta/r^2$. Here κ is the Newtonian gravitational constant; p is the moment of the corresponding dipole ($p>0$); and $r^2 = \rho^2 + z^2$. This solution results in an unsatisfactory form of the gravitational potential V due to the omission of "neglected Schwarzshild terms." The Einstein and Maxwell equations are rewritten, and a series solution is sought in terms of $\kappa m/r$ and $[p(\kappa)^{0.5}]^{0.5}/r$, which are assumed to be small. With $p=0$ these series convert to series obtained by the Schwarzshild solution. The electric and magnetic dipole described by the extrinsic solution shows the "usual" properties. Its total mass is equal to m, and the gravitational field at large distances is Newtonian in character due to the presence of a Schwarzshild term $\kappa m/r$ in the solution. NSA

N68-16513# California Univ., Berkeley. Lawrence Radiation Lab.
EXPERIMENTAL INVESTIGATION OF THE MOTION OF SINGLE CHARGED PARTICLES IN A TRAP WITH MAGNETIC MIRRORS
V. G. Ponomarenko, L. Ya. Trainin, V. I. Yurchenko, and A. N. Yasnetskii Oct. 1967 21 p refs
(UCRL-TRANS-1358) CFSTI: HC $3.00/MF $0.65

Experiments to detect the nonadiabatic escape of electrons from a trap are described. It was established that there exists an area of motion in which the nonadiabatic effects are manifested most intensively. The values characterizing the motion processes which were found from the evaluation of the experimental results depend, in a complex way, on the parameters of the experiment. The method described for measuring the time dependence of the distribution by magnetic moments can be applied when variable fields are present in the working volume. In this case it is necessary to determine by some means the energy distribution of the electrons ejected by the second pulse. Author (NSA)

N68-16519# Academia R. P. R., Bucharest. Institutul de Fizica Atomica.
GAMMA–GAMMA DIRECTIONAL CORRELATION IN THE $^{35}Cl(n,\gamma)^{36}Cl$ REACTION
V. Cojocaru, M. Patrutescu, M. Petrascu, and Marioara Salagean 1967 20 p refs
(IFA-NR-25)

Directional correlations of gamma–gamma cascades in the $^{35}Cl(n,\gamma)^{36}Cl$ reaction having a sum-energy of 8.57, 2.47, 1.95 and 1.68 MeV are measured with a sum-coincidence spectrometer. The results show that the most probable values for the energy level spins are J(0.788)=2, J(1.949)=2 or 3, and J(2.467)=3. Likewise, the multipolarities of some gamma rays belonging to these cascades are established. Author (NSA)

N68-16520# Brookhaven National Lab., Upton, N. Y.
RADIATIVE CAPTURE OF NEUTRONS IN AND BETWEEN RESONANCES
R. E. Chrien 7 Nov. 1967 21 p Presented at Nucl. Phys. Div. Meeting, Madison, Wis., 23 Oct. 1967 Sponsored by AEC
(BNL-11903; CONF-671040-1) CFSTI: HC $3.00/MF $0.65

The advantages of epithermal capture for studying nuclear parameters are outlined and are demonstrated by several recent experiments that were performed at the BNL HFBR using a chopper time-of-flight facility designed specifically for such spectral studies. Differences between the spectra from resonance and thermal capture in ^{197}Au and ^{169}Tm are discussed, together with evidence for potential capture in ^{238}U. An investigation of p-wave capture using epithermal capture in ^{118}Sn is also summarized. NSA

N68-16534# Georgia Inst. of Tech., Atlanta. School of Physics.
IONIZATION AND CHARGE TRANSFER CROSS SECTIONS Progress Report, 1 Dec. 1966–30 Nov. 1967
D. W. Martin and G. O. Taylor 1 Dec. 1967 25 p refs
(Contract AT(40-1)-2591)
(ORO-2591-34; PR-20) CFSTI: HC $3.00/MF $0.65

The general objectives of a program of absolute cross-section measurements for charge rearrangement collisions of fast (0.15 to 1.00 MeV) hydrogen and helium ions and atoms in gaseous targets and the overall plan of the experiment are discussed. Essentially all of the effort during the current report period went into the further construction of the differential coincidence analyzer apparatus. Work on the following parts of the apparatus is described: the retarding potential electrode assembly, the detector for the recoil-ion analyzer, the fast-beam analyzer, alignment, and the auxiliary ion source. NSA

N68-16569# Bettis Atomic Power Lab., Pittsburgh, Pa.
SPATIAL DISTRIBUTIONS IN A ZIRCONIUM WATER LATTICE OF ACCELERATOR SOURCE NEUTRONS
R. W. Stooksberry and M. Goldsmith Sep. 1967 6 p refs Presented at the 15th Conf. on Remote Systems Technol. and Atom Fair, Chicago, Nov. 1967
(Contract AT(11-1)-GEN-14)
(WAPD-T-2015; CONF-671102-37) CFSTI: HC $3.00/MF $0.65

Neutron slowing down in a Zr–H_2O lattice assembly was investigated using an array of parallel zirconium slabs in a tank of water. The indium resonance activation was measured at the midpoint of the water gap (0.987 cm) between slabs for both 2.85–MeV T(p,n)^{3}He and 2.185–MeV D(d,n)^{3}He neutron sources. The indium resonance was obtained by positioning 0.006-in.-thick In–Sn foils with 0.020-in. Cd covers in planes at a distance Z forward of the accelerator target and perpendicular to the ion beam axis. The integral activation was obtained by integration of these data as well as an extrapolated region to infinity. NSA

N68-16573# Norges Tekniske Hoegskole, Trondheim. Institutt for Teoretisk Fysikk.
ABSORPTION OF S-ORBIT π^- MESONS BY ^{4}He
Daniel S. Koltun (Rochester Univ.) and Arne Reitan [1967] 29 p refs Sponsored in part by AEC
(TID-24141) CFSTI: HC $3.00/MF $0.65

The rate of absorption of s-orbit bound π^- mesons by correlated nucleon pairs, and the distributions in momentum and laboratory angle of the emitted fast nn or np pair, are calculated for ^{4}He. The pion is assumed to be absorbed either directly by one nucleon, or by processes that involve exchange of the absorbed pion between the two nucleons in question. The absorbing nucleon pair is assumed to interact in the initial state through a harmonic-oscillator potential plus a short-range (Hamada–Johnston) interaction, and in the final state only through the short-range interaction. Author (NSA)

N68-16576# Amsterdam Univ. (Netherlands).
ATOMIC SCATTERING STUDIES USING SOLID TARGETS (ENERGY RANGE 10–100 KEV)
Cornelis Snoek 1966 93 p refs
(NP-17144)

Collisions of Ar^+ ions against Cu atoms at kinetic energies of 40, 60, and 90 keV were used to study the uses and limitations of solid targets in atomic scattering studies. Absolute measurements of the number of particles scattered in various directions from the (110) surface of a Cu single crystal were made. It was found that these measurements could not be used for determination of the interatomic potential but could be used with an appropriate potential model for determination of the neutral contribution to the scattered particles. Measurements of inelastic energy losses during collisions of Ar^+ ions with Cu atoms at the surface of a solid and with atoms in a Cu vapor beam indicated that the dynamics of atomic collisions is not influenced by the physical state of the target. Differences in energy losses at scattering angles where the outgoing particles leave the target at grazing angles were attributed to additional scattering against neighboring atoms at the surface. The high-energy part (>50 eV) of the energy spectrum of the electrons emitted by metallic targets during ionic bombardment was investigated. It appeared that this spectrum consisted of a background decreasing rapidly at high energies. Superimposed upon this background, peaks characteristic of the collision partners can occur. Possible explanations for these results are considered. NSA

N68-16578# Atomic Energy Commission, New York. Health and Safety Lab.
RELATIVISTIC N–P SCATTERING CALCULATIONS FOR RECOIL PROTON SPECTROMETERS
Ferenc Hajnal Oct. 1967 35 p refs
(HASL-186) CFSTI: HC $3.00/MF $0.65

Two-particle relativistic elastic scattering formulas were adapted for recoil proton spectrometry. The basic equations of the special theory of relativity are reviewed. Elastic scattering is briefly described in the cms and laboratory coordinate systems. Derivations are given for the momentum, velocity, and total and kinetic energies for the scattering and recoil particles in the cms and laboratory coordinate systems before and after scattering. The differential cross sections are then calculated after deriving the scattering and recoil angles in the cms and laboratory systems. The transformation of the physical quantities from the cms to the laboratory coordinate system is described. Empirical fitting of the differential elastic scattering cross sections in the cms system was carried out in the energy range from 27 to 630 MeV. Author (NSA)

N68-16586# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
STABILITY OF A RING CURRENT IN A CYLINDRICAL RESONATOR [USTOICHIVOST' KOL'TSEVOGO TOKA V TSILINDRICHESKOM REZONATORE]
I. I. Ivanov 1967 14 p refs In RUSSIAN
(JINR-P9-3474-2)

If charged beams are inserted in the resonator, then instabilities can arise in it, connected with the interaction of the beam with the natural field of the resonator. An instability of such a type was investigated for ring configurations in the cylindrical resonator. The increments of the growth of the instability in infinitely fine current ring was found. The results were easily generalized to the formation of the type of E layers. All examinations were made in the framework of hydrodynamics with zero thermal moments. Author (NSA)

N68-16587# Edgerton, Germeshausen and Grier, Inc., Santa Barbara, Calif.
A STUDY OF THE NONLINEAR RESPONSE OF NE 102 AND MEL 150-C SCINTILLATORS
J. Stevens and R. E. Knowlen Oct. 1967 57 p refs Prepared for Calif. Univ., Livermore
(Contract W-7405-ENG-48)
(EGG-1183-2158; S-401-R; UCRL-13323) CFSTI: HC $3.00/MF $0.65

Plastic scintillators were measured to determine the peak dose rate for which scintillator light output is linearly proportional to incident flux. These measurements were performed by bombarding 80-mil-thick scintillating discs with 12-MeV electrons. The scintillators' light output was measured with a photodiode, and the resulting signal was compared to that from a Faraday cup which measured the incident electron flux. Nonlinear behavior was observed using pulse widths between 0.5 μsec and 6 nsec. Maximum observed nonlinearity was about 30% for the leading edge. Greater nonlinearity was observed for the back half of the pulse. The total dose or dose rate required to drive NE 102 into nonlinearity is approximately twice that for MEL 150-C. The data indicated that for pulse widths between 30 nsec and 0.5 μsec, NE 102 becomes nonlinear at a total dose of 2.3×10^{13} γMeV/cm^2, while MEL 150-C becomes nonlinear at 1.1×10^{13} γMeV/cm^2. For shorter pulses, nonlinearity is a function of dose rate rather than total dose. For a 6-nsec excitation, NE 102 becomes nonlinear at 8×10^{20} γMeV/cm^2/sec, while MEL 150-C becomes nonlinear at 5×10^{20} γMeV/cm^2/sec. Author (NSA)

N68-16588# Joint Inst. for Nuclear Research, Dubna (USSR).
THE METHOD AND PARAMETER DETERMINATION PROGRAM FOR COMPUTING SPACE COORDINATES OF TRACK POINTS IN A BUBBLE CHAMBER [SPOSOB I PROGRAMMA OPREDELENIYA PARAMETROV DLYA RASCHETA PROSTRANSTVENNYKH KOORDINAT TOCHEK TREKOV V PUZYR'KOVOI KAMERE]
T. Kanarek, L. S. Okhimenko, and Z. M. Kosareva 1967 16 p ref In RUSSIAN
(JINR-P1-3487)

A method for determining the parameters which characterize the scale changes in photographing the distances between particle track points was described. The parameters were used for the calculation of the space coordinates of track points in any bubble chamber. A program for the calculation of the parameters with respect to the coordinates of the datum points, measured on films by means of the UIM-21 microscope for each new exposure of the xenon of the 30-liter chamber in the particle beam, was given. Author (NSA)

N68-16589# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation.
GENERATION OF A FICTITIOUS TRACK [GENERATSIYA FIKTIVNOGO TREKA]
A. D. Makarenkova, V. I. Moroz, A. P. Stel'makh, and G. N. Tentyukova 1967 20 p refs In RUSSIAN
(JINR-P10-3526)

Adjustment and check of the programs of a geometrical reconstruction is made essentially easier if a good test material is available. With that end in view a special program for generation of test tracks of particles with different masses in the retarding medium, situated in an inhomogeneous magnetic field, was created. The account of the measurement errors and the multiple scattering is performed by the Monte Carlo method. The track can be obtained both in the coordinate system of a track chamber and as two projections on the left and right frames of cameras in the chamber. Author (NSA)

N68-16610# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
ENERGY SPECTRUM OF ALPHA PARTICLES FROM THE $^{122}Te(n,\alpha)^{119}Sn$ AND $^{169}Tm(n,\alpha)^{166}Ho$ REACTIONS WITH 14.2-MeV NEUTRONS
M. Jaskola, W. Osakiewicz, J. Turkiewicz, and Z. Wilhelmi 1967 12 p refs
(INR-814-I-PL)

The energy spectrum of alpha particles from the $^{122}Te(n,\alpha)^{119}Sn$ and $^{169}Tm(n,\alpha)^{166}Ho$ reactions at 14.2 MeV was studied using the semiconductor detector technique. The analysis of the energy spectrum leads to results that the evaporation theory is inadequate to the description of the investigated reactions. The shapes of the experimental spectra suggest the presence of strong direct effects in the investigated reactions. Author (NSA

N68-16611# Tokyo Univ. (Japan). Inst. for Nuclear Study.
LIST OF MEMBERS OF QUASI-GROUND, QUASI-BETA, AND QUASI-GAMMA BANDS
Mitsuo Sakai 1 Sep. 1967 25 p refs
(INSJ-105)

Excited levels in even-even nuclei are classified into so-called quasi-ground, quasi-beta and quasi-gamma bands which have been observed in all the nuclear regions. The experimental compilation indicates that the heads of the quasi-beta and quasi-gamma bands are more of collective character and have a larger effective moment of inertia than for the ground state. Author (NSA)

N68-16612# Atomic Energy Commission, New York. Health and Safety Lab.
NEUTRON SHIELDING OF THE LOS ALAMOS MESON PHYSICS FACILITY
Keran O'Brien Nov. 1967 11 p refs
(HASL-188) CFSTI: HC $3.00/MF $0.65

Neutron fluxes and dose-equivalent rates in the lateral shielding of the Los Alamos Meson Physics Facility were calculated using neutron cascade theory. Two values of the hydrogen atom concentration were assumed, to test the sensitivity of neutron dose-rates to the water content. The lateral shielding of the accelerator, which is of earth, was assumed to have an average atomic number of 13. Author (NSA)

N68-16613# Battelle-Northwest, Richland, Wash.
A METHOD FOR CALCULATION OF GROUP-AVERAGE RESONANCE PARAMETERS
James H. Nail, James R. Sheff, and Alan H. Robinson 2 Nov. 1967 31 p Presented at the 15th Conf. on Remote Systems Technol. and Atom Fair, Chicago
(Contract AT(45-1)-1830)
(BNWL-SA-1334; CONF-671102-34) CFSTI: HC $3.00/MF $0.65

A method of averaging resonance parameters of multiple energy group calculations of resonance cross sections is presented. The method generates average resonance parameters which require only a few pieces of storage information compared to the large amount of storage information required for most isotopes. The narrow resonance-infinite absorber assumption is used for the approximation. NSA

N68-16614# Brookhaven National Lab., Upton, N. Y.
SYMMETRY TESTS WITH THE MOESSBAUER EFFECT
O. C. Kistner 23 Aug. 1967 36 p refs Presented at the Intern. Conf. on Hyperfine Interactions, Pacific Grove, Calif.
(BNL-11696; CONF-670812-8) CFSTI: HC $3.00/MF $0.65

The Mossbauer experiments designed to test parity conservation in the 14-keV transition in ^{57}Fe were reviewed. How the Moessbauer effect can be applied to the more complicated test of time reversal invariance is described and is illustrated with an experiment performed at Brookhaven which employed the 90 keV M1/E2 mixed transition in ^{99}Ru. NSA

N68-16615# Sandia Corp., Albuquerque, N. Mex.
TWO-NEUTRON CONFIGURATIONS IN THE EVEN CALCIUM ISOTOPES AS OBSERVED IN THE (t,p) REACTION
David C. Williams Nov. 1967 12 p refs Presented at the Meeting of the Div. of Nucl. Phys., Madison, Wis.
(Contract AT(29-1)-789)
(SC-DC-67-2032; CONF-671040-3)

Recent data on the reactions $^{40,44,46,48}Ca(t,p)$ are summarized. The strong transitions may be interpreted without assuming heavy mixing of the various two-neutron configurations that are the principal contributors to the (t,p) reaction amplitude, though these configurations evidently do mix with configurations involving core excitation. Thus, the strong transitions of a given L value are grouped in such a way that each group may be assigned

to one of the expected two-neutron configurations having the appropriate J^{π}. The interpretation offered indicates that the configurations $[f_{7/2}^{-2})J_1=0\ f_{7/2}p_{3/2}]$ and $[f_{7/2}^{-2})J_1=0\ p_{3/2}^2]$ constitute at most minor components of states below 4.4 MeV in $^{42,46}Ca$; recent $^{43}Ca(d,p)$ data indicate that the same is true of ^{44}Ca. States of the (20/20) core are important. This description differs from treatments of these isotopes which emphasize mixtures of the various $1f_{7/2}-2p_{3/2}$ neutron configurations and consider states of the (20/20) core only secondarily, if at all. Author (NSA)

N68-16616# Georgia Inst. of Tech., Atlanta. School of Physics.
EMISSION AND EXCITATION CROSS SECTIONS Progress Report, 1 Dec. 1966–30 Nov. 1967
E. W. Thomas, J. L. Edwards, and G. D. Bent 1 Dec. 1967 38 p refs
(Contract AT(40-1)-2591)
(ORO-2591-33; PR-3) CFSTI: HC$3.00/MF$0.65

The objectives and general methods of a program for measurement of cross sections for production of particles in excited states as the result of the impact of 0.15- to 1.0-MeV protons on various gaseous targets under single-collision conditions are discussed. Reports are listed in which completed work is described. Some additional observations not to be published because they are considered of poor quality are discussed briefly. These observations concern formation of excited states in He, N_2, O_2, H_2, and Ar. Preliminary results on Balmer alpha emission following proton impact on nitrogen are also presented briefly. NSA

N68-16620# Atomics International, Canoga Park, Calif.
GRAMS: A FORTRAM PROGRAM TO SOLVE GAMMA RAY PENETRATION PROBLEMS IN MULTISLAB SHIELDS. VOLUME 1: NUMERICAL METHODS
Bruce D. O'Reilly and Richard C. Lewis 22 Jun. 1967 60 p refs
(Contract AT(04-3)-701)
(NAA-SR-12337, v. 1) CFSTI: HC$3.00/MF$0.65

The numerical analytic methods used to solve the one-dimensional energy-dependent transport equation for gamma rays migrating through a multislab shield are described. These methods are organized into a systematic procedure for solving the entire problem. This procedure has been used to develop the Fortran code GRAMS, which implements the numerical solution of the problem. Author (NSA)

N68-16624# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
PROGRESS REPORT, OCTOBER 1, 1967 TO DECEMBER 31, 1967
31 Dec. 1967 85 p
(AECL-3009; PR-P-76) Available from Atomic Energy of Canada, Ltd., Chalk River: $2.00

Abstracted data are presented on the various projects pertaining to nuclear physics research, solid state studies, solid state radiation detectors, and computation techniques. Similar information is also given on the several projects relating to space physics, neutron physics, and theoretical physics. A bibliography of reports, publications, and lectures is included. M.G.J.

N68-16637# General Electric Co., Pleasanton, Calif. Nucleonics Lab.
A SURVEY AND EVALUATION OF THERMAL FISSION YIELDS FOR U-235, Pu-239, AND Pu-241
B. F. Rider, C. P. Ruiz, J. P. Peterson, Jr., and F. R. Smith 1 Mar. 1967 51 p refs
(Contract AT(04-3)-189)
(GEAP-5358) CFSTI: HC$3.00/MF$0.65

The accurate determination of atom percent fission (burnup) in nuclear fuel by the fission product-to-fuel ratio method requires the use of accurate fission yields in the calculation. Recent measurements of chain yields in thermal-neutron induced fission of U-235, Pu-239, U-233, and Pu-241 have been made to improve the accuracy of fission yields. Fission yield accuracies of several mass chains used for burnup analysis now approach 2% at the 95% confidence level. Thermal fission yields published through June 1967 are compiled and are evaluated. From this compilation a set of thermal fission yields is prepared for use in nuclear fuel burnup analysis. Author (NSA)

N68-16638# General Electric Co., Pleasanton, Calif. Nucleonics Lab.
BURNUP: A FORTRAN 4 CODE FOR COMPUTING U AND PU FUEL BURNUP FROM U, PU, AND ND MASS SPECTROMETRIC MEASUREMENTS
B. F. Rider, C. P. Ruiz, J. P. Peterson, Jr., and T. V. McLaughlin 1 Mar. 1967 103 p refs
(Contract AT(04-3)-189)
(GEAP-5355) CFSTI: HC$3.00/MF$0.65

Heavy element isotopic analysis is correlated with fission product Nd, U, and Pu concentrations in an irradiated U fuel for calculation of burnup (atom percent fission and MWd/MT). Certain reactor parameters including effective neutron absorption cross sections for all U and Pu isotopes, capture-to-fission ratios for U-235, Pu-239 and Pu-241, a two-group description of the neutron spectrum, the average neutron temperature, the reactor fast fission factor, and the distribution of the sources of fission among the fissionable nuclides are computed from the experimental measurements. A description of the method, the equations used, and instructions for use of the code are included. Author (NSA)

N68-16645# Oak Ridge National Lab., Tenn.
A FORTRAN PROGRAM FOR RELATIVISTIC KINEMATIC CALCULATIONS IN TWO-BODY NUCLEAR REACTIONS
R. E. Phillips and T. S. Thornton Nov. 1967 25 p refs
(Contract W-7405-ENG-26)
(ONRL-4179; UC-34) CFSTI: HC$3.00/MF$0.65

A program was developed for calculating the kinematics of two-body nuclear reactions using relativistic formulas. The energies and scattering angles of the two decay particles in the laboratory system and the energies of all four particles in the center-of-mass system, along with the center-of-mass to laboratory differential cross-section ratio are calculated. The input consists of the four masses, the Q-value, the laboratory scattering angle, and the initial laboratory bombarding energy. The program exists for both the Control Data 1604-A and IBM System/360 Model 75 computers in both regular and double precision FORTRAN. Author (NSA)

N68-16647# Los Alamos Scientific Lab., N. Mex.
RADIATION CHARACTERISTICS OF PLUTONIUM-238
George M. Matlack and Charles F. Metz 11 Oct. 1967 12 p refs
(Contract W-7405-ENG-36)
(LA-3696; UC-41) CFSTI: HC$3.00/MF$0.65

The primary hazard in the use of ^{238}Pu as a biomedical power source results from the neutron flux caused by spontaneous fission and (α,n) reactions with light elements. Spontaneous

fission will cause an activity of approximately 2200 neutrons per gram-second for material containing 81% ^{238}Pu. Neutrons from (α,n) reactions can increase this value to 8,000 to 10,000 unless every effort is made to produce ^{238}Pu which is extremely free of light element impurities. Most of the gamma radiation is of low energy and easily shielded. A significant fraction of the gamma radiation will, however, be caused by the growth of ^{241}Am, and by the 4n heavy element decay chain resulting from the decay of small amounts of ^{236}Pu. Gamma radiation from spontaneous fission and fission-product decay will be negligible. Author (NSA)

N68-16652*# Florida Univ., Gainesville. Dept. of Physics.
STUDIES OF LOW-ENERGY IONIC COLLISIONS Final Report, 1 Oct. 1965–30 Sep. 1967
T. L. Bailey and B. S. Thomas Sep. 1967 22 p refs
(Grants NSG-543; AF-AFOSR-471-64)
(NASA-CR-93125; AFOSR-67-2669; AD-661975) CFSTI: HC $3.00/MF $0.65 CSCL 20H

Experimental and theoretical research on low-energy ionic collisions is described. The program developed an angular ion-scattering apparatus of improved accuracy and reproducibility for the collision dynamics of ions against neutral atoms and molecules in the 1-200 eV energy range. Emphasis was placed on three classes of investigations: (a) collision induced dissociation, (b) ion-molecule reactions, (c) collisions of doubly-charged ions with diatomic molecules. The experiments were successful in determining both angular and kinetic energy distributions of charged products. In addition improved theoretic models were developed on elastic scattering using the JWKB (Jeffreys-Wentzel-Kramers-Brillouin) approximation. Enhancement of experimental resolution was also improved, using a locally developed numerical unfolding procedure. Author (TAB)

N68-16658# Atomic Energy Commission Research Establishment, Riso (Denmark).
MEASUREMENT OF THERMAL NEUTRON BEAM DENSITIES. 1: PRECISION MEASUREMENT USING A ^{3}He PROPORTIONAL COUNTER. 2: CORRECTIONS TO THE GOLD FOIL ACTIVATION METHOD FOR DETERMINING NEUTRON BEAM DENSITY
J. Als-Nielsen, A. Bahnsen (Rochester Univ.), and W. K. Brown (Los Alamos Sci. Lab.) Dec. 1966 57 p refs
(RISO-144)

A new method, based on the ^{3}He(n,p)T reaction, was developed for the accurate determination of thermal neutron beam densities. Several comparisons were made with the conventional Au foil activation method, and agreement was obtained between the two methods within an experimental uncertainty of ±0.4%. Fundamental advantages of the method include the 1/v dependence of the ^{3}He(n,p)T cross section up to 1 keV, and the assurance of homogeneity even for very small macroscopic cross sections because of the gaseous detector material. Although the method requires a relatively clean neutron beam, it can be used over a wide range of neutron densities and, in particular, is capable of measuring extremely weak beams. A detector was constructed which has a well-defined efficiency and is able to accept beams of diameters up to 10 cm. The ^{3}He counter method is proposed as a precision standard for the absolute measurement of thermal neutron beam densities. Author (NSA)

N68-16668*# Ohio State Univ., Columbus. Electroscience Lab.
EXCITATION CROSS SECTION FOR SOME OF THE DOUBLY IONIZED STATES OF ARGON, NEON AND KRYPTON BY FAST ELECTRONS
S. H. Koozekanani 8 Jan. 1968 26 p refs
(Grant NsG-74-60)
(NASA-CR-92882, Rept.-1093-36) CFSTI: HC $3.00/MF $0.65 CSCL 20H

The excitation cross section for the doubly ionized states of argon, neon, and krypton has been found for the process where a fast moving free electron impinges upon a neutral atom causing the neutral atom to go from I^{N} to $(I^{N-3}-n\ell')$ in a very short time compared to the relaxation time of the ion. Author

N68-16685# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics.
NEUTRON CROSS SECTIONS AND THE FORCE FUNCTION OF GERMANIUM ISOTOPES [NEITRONNYE POPERECHNYE SECHENIYA I SILOVYE FUNKTSII IZOTOPOR GERMANIYA]
Kh. Maletski, L. B. Pikel'ner, I. M. Salamatin, and E. I. Sharapov 1967 14 p refs In RUSSIAN
(JINR-P3-3456)

The passage, self-indication, and radiative capture of neutrons in separated isotopes of Ge were investigated using the pulsed IBR reactor with a microtron. The parameters of the levels in the range up to 30 keV for even isotopes and up to 9 keV for odd isotopes were obtained. For two isotopes, the values of the strength function, the mean distances between levels, and the mean radiation widths were found. Author (NSA)

N68-16686# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
PION SCATTERING ON THE ALIGNED DEUTERON. DEUTERON STRUCTURE [RASSEYANIE π-MEZONOV NA VYSTROENNOM DEITRONE I STRUKTURA DEITRONA]
Ch. Tseren 1967 8 p refs In RUSSIAN
(JINR-P2-3546)

The consideration of the multiple scattering of particles on the nucleons in a nucleus leads to two effects; first, the spin-independent part of the cross section is changed; second, the dependence of the total cross section upon the aligned deuteron appears. Thus the total π-d cross section can be written from the performance of the standard transformations. For the first time the value $\delta\sigma$ in the diffraction approximation was estimated. In this approximation the value σ_1 was calculated. The deuteron wave function at small distances was chosen. Then using certain relations, the expression for σ_1 was obtained. Author (NSA)

N68-16690# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
LIFETIME OF THE 242.8-KEV LEVEL IN ^{165}Er NUCLEI [VREMYA ZHIZNI UROVNYA 242,8 KEV V YADRE ^{165}Er]
G. T. Adylov, R. Babadzhanov, A. S. Kuchma, and V. A. Morozov 1967 13 p refs In RUSSIAN
(JINR-P6-3492)

Using a multichannel analyzer with a time-to amplitude converter, the lifetime of the 242.8-keV level in ^{165}Er from the decay of ^{165}Tm ($T_{1/2}$=29 hrs) was measured. The coincidences of the conversion electrons of the 242.8-keV transition with the γ rays with energy above 1132 keV were analyzed. The half-life of the 242.8-keV level was found to be $3.21\pm0.51\times10^{-10}$ sec. F_M and F_N were determined for the transitions with the energy 242.8 (keV) (M1+E2); 195.7 (E1); and 165.6 (E2) going from this state to the states $5/2^{-[523]}$; $5/2^{+[642]}$, and $7/2^{-}$ $5/2^{-[523]}$, respectively. Author (NSA)

N68-16691# Aktiebolaget Atomenergi, Stockholm (Sweden).
NEUTRON ELASTIC SCATTERING CROSS SECTIONS OF THE ELEMENTS Ni, Co, and Cu BETWEEN 1.5 AND 8.0 MEV
B. Holmquist and T. Wiedling Dec. 1967 17 p refs
(AE-303)

Angular distributions of elastically scattered neutrons have been measured for natural nickel at seven energies between 3.0 and 8.1 MeV and for cobalt and copper at ten energies between 1.5 and 8.1 MeV, by using time-of-flight technique. The observed angular distributions were corrected for neutron flux attenuation, multiple elastic scattering, and the finite geometry of the source-sample-detector system by using a Monte Carlo computer program. Theoretical angular distributions have been fitted to the experimental angular distributions by using an optical model potential with Saxon–Woods form factors. A computer program was used to find parameter values of the potential giving the best fittings to the experimental angular distributions. Author

N68-16703# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics.
APPLICATION OF POLARIMETER WITH ANNULAR ANALYZER FOR INVESTIGATION OF PROTON POLARIZATION FROM NUCLEAR REACTIONS [PRIMENENIE POLYARIMETRA S KOLTSEVYM ANALIZATOROM DLYA ISSLEDOVANIYA POLYARIZATSII PROTONOV IZ YADERNYKH REAKTSII]
M. I. Krivopustov, I. V. Sizon, G. Shirmer, and G. Eler 1967 55 p refs in RUSSIAN
(JINR-P15-3504)

The annular geometry for measurements of the polarization of nuclear reaction products is described. Data on the angular and energy dependence of proton polarization from the reaction of ^3He with carbon are given. Author (NSA)

N68-16706# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
NEW RESULTS OF THE PHASE-SHIFT ANALYSIS OF THE NUCLEON–NUCLEON SCATTERING AT 630 MEV [NOVYE REZULTATY FAZOVOGO ANALIZA NUKLON–NUKLONNOGO RASSEYANIYA PRI ENERGII 630 MEV]
L. M. Glonti, Yu. M. Kazarinov, A. M. Rozanova, and I. N. Silin 1967 32 p refs In RUSSIAN
(JINR-P1-3525)

The phase-shift analysis of data on the nucleon–nucleon scattering at the energies near to 630 MeV was performed. It is shown that under the assumption of the validity of one-meson approximation, beginning from the orbital moments $l = 6$, the number of solutions with $\chi^2 \leq 1.6^{-2}$ is equal to 5. Using a stronger criterion than the χ^2-one, one can show that the maximum probability of a first type error rejecting certain solutions is 5.10^{-4}, 5.10^{-4}, and 4%, respectively. A new set appears which differs essentially from the previously known set. An additional set appears when taking into account the meson production from the nonresonance state $^3F_4$. Author (NSA)

N68-16708# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
CHARGE DIVERGENCE COMMUTATOR
M. Micu 1967 8 p refs
(JINR-E2-3558)

From the commutator of a charge with the divergence of the corresponding current an equation for the electromagnetic form factor of the π-meson is obtained. This equation gives a correct value for electromagnetic self-energy and a wrong magnitude and sign for mean square radius. Taking into account ω-meson intermediate states the result is not improved. Author (NSA)

N68-16710# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
RELATIVISTIC STOCHASTIC PROCESSES
Remi Hakim Nov. 1967 46 p refs
(TH/227)

Relativistic stochastic processes in μ-space are defined and studied in a completely (and manifestly) covariant manner, without particularizing the time variable. It is shown that a number of usual definitions such as "Gaussian process' etc...cannot be given a fully invariant meaning. Markovian processes are also studied. We find anew, as a particular case, results already obtained by J. Lopuszanski in the case of Markovian processes in Minkowski spacetime. Several suggestions are made to generalize these results. Author

N68-16718# Atomic Energy Establishment, Winfrith (England).
THE WINFRITH DSN PROGRAMME, MARK 2
C. Green Sep. 1967 51 p refs
(AEEW-R-498) CFSTI: HC $3.00/MF $0.65

The program solves the multigroup discrete S_n approximation to the Boltzmann neutron transport equation and is written in FORTRAN for the KDF 9 computer. It is considerably faster, and now includes plane and spherical geometries, in addition to the cylindrical geometry originally allowed; an option permitting adjoint or anisotropic problems to be solved is given. A further program, WSN, based on the Carlson discrete S_n method has been written and is also reported. NSA

N68-16726 Australian National Univ., Canberra. Dept. of Engineering Physics.
ON THE INTEGRATION OF "BOLTZMANN-LIKE" COLLISION INTEGRALS
E. L. Bydder and B. S. Liley Mar. 1967 37 p refs
(EP-RR-15)

Boltzmann-like collision integrals are reduced to sums of the generalised collision "frequencies", Ω. The mathematical formulation is such that all possible types of binary encounters are considered, including inelastic, charge exchange, recombination and collisions of the second kind. However, only the relevant mathematics is presented, the relevant physics being given elsewhere. In this sense, this report is merely an appendix to other publications. Author

N68-16734# Utrecht State Univ., (Netherlands).
THE $^{52}Cr(p,\gamma)^{53}Mn$ REACTION
Petrus Hendrikus Vuister 1966 63 p refs
(NP-17149)

The reaction $^{52}Cr(p,\gamma)^{53}Mn$ was investigated in the energy region $E_p = 1.38$ to 2.26 MeV. The resonance energies, the corresponding ^{53}Mn excitation energies, and the resonance strengths of 199 resonances, assigned to this reaction, are reported. The excitation energies and gamma-ray branchings of 13 bound states were determined from the measurement of single and coincidence gamma-ray spectra at 20 resonances. The excitation energies are in excellent agreement with values recently obtained with the $^{56}Fe(p,\alpha)^{53}Mn$ reaction. Author (NSA)

N68-16736# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.

EPITHERMAL NEUTRON INELASTIC SCATTERING BY POLYETHYLENE

W. E. Moore, G. J. Kirouac, L. J. Esch, K. W. Seemann, and M. L. Yeater (Rensselaer Polytech. Inst., Troy, N. Y.) [1967] 10 p refs Presented by the 2d Symp. on Mater. Res. and Mol. Dyn. and Struct. of Solids, Gaithersburg, Md., 16–19 Oct. 1967 Prepared jointly with Rensselaer Polytech. Inst., Troy, N. Y.

(Contracts W-31-109-ENG-52; AT(30-3)-328)

(RPI-328-102; CONF-671028-3) CFSTI: HC $3.00/MF $0.65

Double differential scattering data were obtained for a thin sample of high density polyethylene at room temperature, using the RPI-KAPL neutron spectrometer. Incident neutron energies in the range 0.1 to 1 eV are used, permitting a wide range of energy and momentum exchange to be studied. Evidence was seen in the data for known vibrational states between 0.09 and 0.18 eV, and at 0.36 eV. In addition, scattering from the acoustic modes for torsional ans stretch–bend carbon chain vibrations was observed. Some initial comparisons with theoretical models were made. Author (NSA)

N68-16741# Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik.

ENERGY AND TEMPERATURE DEPENDENT CAPTURE MEASUREMENTS BELOW KEV SUPPORTING DOPPLER EFFECT CALCULATIONS

H. Seufert and D. Stegemann Oct. 1967 25 p refs Presented at the Symp. on Fast Reactor Phys. and Related Safety Probl., Karlsruhe, West Ger., 30 Oct.–3 Nov. 1967 Sponsored by US-EURATOM

(EURFNR-400; EUR-3675.E; KFK-631; SM-101/17; CONF-671043-10) CFSTI: HC $3.00/MF $0.65

Energy- and temperature-dependent capture measurements below 30 keV neutron energy were performed in natural uranium, tungsten, and tantalum using the slowing-down-time spectrometer technique. Because the energy range below 30 keV neutron energy is most interesting for Doppler-effect investigating the slowing-down-time spectrometer is used to measure the capture ratios of hot-to-cold samples of natural uranium, tungsten, and tantalum. Thin samples were heated to different temperatures for this purpose, and the capture γ rays were detected by proportional counters. Because hot-to-cold capture ratios are measured the knowledge of the neutron flux is not necessary; therefore, a direct comparison of calculated and measured temperature-dependent cross sections is possible. A theoretical analysis of the experimental data for uranium is given. Author (NSA)

N68-16743# Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik.

THE GROUP CROSS-SECTION SET KFK-SNEAK: PREPARATION AND RESULTS

H. Bachmann, H. Huschke, E. Kiefhaber, B. Krieg, H. Kuesters et al Oct. 1967 27 p refs Presented at the Symp. on Fast Reactor Phys. and Related Safety Probl., Karlsruhe, West Ger., 30 Oct.–3 Nov. 1967 Sponsored by US-EURATOM

(EURFNR-397; EUR-3672.E; KFK-628; SM-101/12; CONF-671043-1) CFSTI: $3.00/MF $0.65

Methods used in calculating infinite dilute group constants are presented. A comparison of the main differences in the basic data is shown. During the preparation of the group constant set the influence of the data on integral quantities for SNEAK 3A-2 is studied. NSA

N68-16806# Brookhaven National Lab., Upton, N. Y. Health Physics Div.

RADIAL DISTRIBUTION OF DOSE ALONG HEAVY ION TRACKS, LET_r

J. W. Baum, S. L. Stone, and A. V. Kuehner [1967] 25 p refs Presented at the Symp. on Microdosimetry, Ispra, Italy, 13–15 Nov. 1967 Sponsored by AEC

(BNL-11877; CONF-671109-1) CFSTI: HC $3.00/MF $0.65

The radial distribution of dose for 100 to 300 keV protons incident on hydrogen was calculated with the aid of a digital computer. Cross sections, differential in angle and energy, provided input data on ejected electrons. In the absence of published data, a curve for dE/dx of 0 to 1 keV electrons in hydrogen was generated from available cross section data. Dose contributed by each electron was then considered and summed to arrive at ergs/cc as a function of radial distance from the track and integral dose out to various radial distances. A 3-foot long, 1-foot diameter cylindrical ionization chamber with segmented collection electrodes was employed in the experimental portion of the investigation. The segmented electrode permits collection from portions of the chamber which are in equilibrium with the secondary electron distribution. By lowering the pressure in the chamber, the radial dose distribution is expanded for measurement of LET_r. Measurements of LET_r are reported being made for alphas incident on various gases. Results are compared with values predicted by the calculations for protons on hydrogen, Jaffé theory, and calculations based on recent work of Butts and Katz. Author (NSA)

N68-16820# Joint Inst. for Nuclear Research, Dubna (USSR).

ISOMERIC STATE OF $I^{\pi} = 11/2^-(h_{11/2}-)^{137}Nd$ AND ^{137}Pr TYPE. THE NEW ISOTOPE ^{136}Nd [OB IZOMERNYKH SOSTOYANIYAKH TIPA $I^{\pi} = 11/2^-(H_{11/2}-)$ ^{137}Nd I ^{137}Pr NOVYI IZOTOP ^{136}Nd]

Zh. T. Zhelev, V. G. Kalinnikov, Ya. Liptak, and L. K. Peker 1967 19 p refs In RUSSIAN

(JINR-P6-3468)

The previously unknown isotope ^{136}Nd was identified. The decay scheme $^{136}Nd \xrightarrow{55\ min} {}^{136}Pr \xrightarrow{13.5\ min} {}^{136}Ce$ was proposed. It was shown that the nucleus ^{137}Nd has an isomeric state of the type $h_{11/2}(T_{1/2} = 55\ min)$. The half-life 22 ± 2 min was attributed to the ground state of ^{137}Nd $(d_{3/2})$. Author (NSA)

N68-16829# International Union of Pure and Applied Chemistry, Basle (Switzerland).

BIBLIOGRAPHY ON THE HIGH TEMPERATURE CHEMISTRY AND PHYSICS OF GASES AND PLASMAS

L. Brewer, comp. (Calif. Univ., Berkeley) 31 Dec. 1967 47 p refs Sponsored in part by Natl. Bur. of Std. *Its* No. 25

Annotated bibliographic citations are presented on spectroscopy relating to high temperature chemistry, and reactions between gases and condensed phases. There are 256 entries in the first category, and 181 entries in the latter category. E.C.

N68-16841*# National Aeronautics and Space Administration, Washington, D. C.

COLLISION INTEGRALS, EFFECTIVE CROSS SECTIONS, AND ANGLES OF DEVIATION FOR THE MORSE POTENTIAL

Ye. V. Samuylov and N. N. Tsitelauri *In its* Studies in Phys. Gas Dyn. Feb. 1968 p 13–24 refs (See N68-16839 07-12)

Presented are results of calculations of collision integrals for the Morse potential for $\beta = 1.5$, and results of calculations of deviation and the effective cross sections for the Morse potential for various interactions between gas molecules, atoms, and ions. Basic information concerning the Morse potential and tabulated quantities are also given. S.C.W.

N68-16842*# National Aeronautics and Space Administration, Washington, D. C.

ATTRACTIVE INTERACTION POTENTIALS BETWEEN Li–Li ATOMS IN GROUND STATES

Ye. V. Samuylov and N. V. Voskresenskaya *In its* Studies in Phys. Gas Dyn. Feb. 1968 p 25–30 refs (See N68-16839 07-12)

Described is a method for calculating attractive potential energy curves in which the vibrational energy of a diatomic molecule is expressed in the form of a power series $(v+1/2)$ (v is the vibrational quantum number) which includes any powers of $(v+1/2)$ above the second power. Attractive curves were computed for the Li–Li interaction, with and without the second power of $(v+1/2)$ taken into account in a series for B_v. Calculated values of r_{min} and r_{max} are presented for all values of the vibrational quantum number from $v=0$ to $v=v_{max}$, where v_{max} is the maximum value of the vibrational quantum number at which the molecule is stable. S.C.W.

N68-16844*# National Aeronautics and Space Administration, Washington, D. C.

CALCULATION OF PHOTOIONIZATION CROSS SECTIONS OF NITROGEN AND OXYGEN ATOMS AND THEIR IONS IN EXCITED STATES

V. M. Nikolayev and Yu. A. Plastinin *In its* Studies in Phys. Gas. Dyn. Feb. 1968 p 35–41 refs (See N68-16839 07-12)

Presented are results of calculating photoionization cross sections of nitrogen and oxygen atoms by the quantum defect method in the spectral range of $\lambda \geq 0.12$ μm. Advantages of the calculation procedure over previously reported methods are discussed. S.C.W.

N68-16845*# National Aeronautics and Space Administration, Washington, D. C.

ABSORPTION CROSS SECTIONS OF ELECTRONIC BAND SYSTEMS OF DIATOMIC N_2, O_2, N_2^+, NO, C_2, AND CN MOLECULES AT HIGH TEMPERATURES

Yu. A. Plastinin and G. G. Baula *In its* Studies in Phys. Gas Dyn. Feb. 1968 p 42–62 refs (See N68-16839 07-12)

Presented are results of calculations of the absorption cross sections of electo electronic band systems of diatomic N_2, O_2, N_2, NO, C_2, and CN molecules which were made in a broad spectral range and in a large temperature interval of T=2,000 to 20,000°K. Included are brief notes on the matrix elements of electronic band systems of these molecules. S.C.W.

N68-16847*# National Aeronautics and Space Administration, Washington, D. C.

AN EXPERIMENTAL DETERMINATION OF OSCILLATOR STRENGTH OF THE VIOLET SYSTEM OF THE CN RADICAL

Ye. A. Ambartsumyan, P. V. Ionov, and A. A. Kon'kov *In its* Studies in Phys. Gas Dyn. Feb. 1968 p 76–85 (See N68-16839 07-12)

In view of measurement inaccuracies inherent in available methods for theoretically calculating oscillator strengths, a study was undertaken to explore the possibility of measuring the radiation and absorption capacity of the (0,0) band of the violet system of CN in the temperature range of 5,000 to 10,000°K, using new techniques. Evaluated is the proficiency of the proposed methods for calculating oscillator strength values of the CN violet system. S.C.W.

N68-16853*# National Aeronautics and Space Administration, Washington, D. C.

EXPERIMENTAL DETERMINATION OF ELECTRON CONCENTRATIONS AND EFFECTIVE FREQUENCIES OF ELECTRON COLLISION WITH NEUTRAL PARTICLES IN AIR, N_2, O_2, CO, ARGON AND CO_2 BEHIND SHOCK WAVES

Yu. S. Lobastov *In its* Studies in Phys. Gas Dyn. Feb. 1968 p 126–137 refs (See N68-16839 07-12)

Electron concentrations and effective frequencies of electron collision with neutral particles in air, N_2, O_2, CO, argon, and CO_2 behind shock waves were experimentally determined by measuring the attenuation of radio waves simultaneously at two frequencies, 37,500 MHz and 18,750 MHz. Results indicated that equilibrium ionization is achieved in air and nitrogen in 70–170 μsec at 2,800-4, 800°K and pressures of 0.3–6.20 atm. Comparison of the absorption curves with Toplor scannings of the process of reflection of a shock wave from the end of the tube made it possible to explain the significant increase in conductivity after its achievement of the equilibrium value as a result of additional heating of the gas of a shock wave that had been reflected from a contact surface. The measured values of effective cross sections of electron collisions with neutral particles in air, nitrogen, and CO were similar to those previously reported; however, the cross section in nitrogen at temperatures above 4,000°K tended towards a steeper growth. The cross sections were significantly smaller in molecular oxygen and in CO_2 than in previously reported experiments. S.C.W.

N68-16868# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.

FOUR: MOMENTUM TRANSFER DISTRIBUTION IN HIGH ENERGY, HIGH MULTIPLICITY REACTIONS

G. Bialkowski and R. Sosnowski 1967 10 p refs Submitted for publication
(INR-833/6)

The four momentum transfer distribution to the secondary nucleon in high energy, high multiplicity pion–proton interactions is discussed. It is shown that introducing corrections for the available phase space distributions of the four momentum transfer t in many body reactions are obtained similar to those for two body processes. It is demonstrated that the most characteristic features of high multiplicity π^+–p interactions at 8 GeV/c can be reproduced assuming that the transition matrix element for these interactions depends only on t. Author (NSA)

N68-16869# Tokyo Univ. (Japan). Dept. of Physics.

BREAKDOWN OF O(4) SYMMETRY AND THE BETHE–SALPETER EQUATION

Seiichi Naito Dec. 1967 44 p refs

We consider the Bethe–Salpeter equation for two spinless particles interacting through a massive scalar field. After the Wick rotation the equation becomes O(4)-invariant in the limit of zero energy-momentum. When the total energy is non-zero, the equation is no longer O(4)-invariant, but one can show that the solution in the former case can be smoothly continued to that in the latter case by changing the coupling constant continuously. In solving the eigenvalue problem for the Bethe–Salpeter equation, it is more convenient to regard the coupling constant as a function of the bound state mass than to do the opposite. Then one can show that λ, or the product of two coupling constants, is real in the case when the zero energy-momentum state has no extra degeneracy except for that resulting from O(4). One can also show in our model that a massless bound state exists for any value of the coupling constant for which zero energy-momentum states exist.

Finally, the relation between the parity under a sign change of the relative energy and the Regge pole signature is discussed. Author

N68-16887# Bettis Atomic Power Lab., Pittsburgh, Pa.
Pa-233 RESONANCE INTEGRAL MEASUREMENTS
J. C. Connor, R. T. Bayard, D. Macdonald, and S. B. Gunst Sep. 1967 17 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-612) CFSTI: HC $3.00/MF $0.65

The neutron capture resonance integral of ^{233}Pa was measured by irradiating cadmium-covered thorium wires, and, after suitable chemical separations, determining the quantity of ^{234}U produced. Results are reported for two methods of measuring the irradiating flux. Monitor wires of cobalt in aluminum alloy give integrated fluxes based upon a value of 72.0 barns for the resonance integral of ^{59}Co. Alternatively, measurements of the ^{233}U produced by the irradiations give integrated fluxes based upon an effective resonance integral of 36.5 barns measured for the ^{232}Th wires. The experiments provide ^{233}Pa resonance integral results of 846±43 barns employing cobalt-monitored fluxes, and 837±43 barns employing thorium-monitored fluxes. These results, which have an average value of 842±35 barns, include the 1/v component of the cross section and are appropriate for a 1/E spectrum and a perfect filter with a low energy cut-off of 0.50 eV. Author (NSA)

N68-16902# Tokyo Univ. (Japan). Dept. of Physics.
SPECTRAL FUNCTION SUM RULES FOR THE CURRENTS CARRYING SPIN 2
S. Iwao 17 Dec. 1967 6 p refs
(TUEP-67-29)

Spectral representation for the symmetric tensor currents is derived by conjecturing the new PCTC and PCATC hypotheses in addition to the known CVC and PCAC ones. Assuming the equality of the Fourier transforms of the vacuum expectation value of the time-ordered products of two tensor and two axial-tensor currents at infinite momentum we find new sum rules for the spectral functions. Author

N68-16909# Brookhaven National Lab., Upton, N. Y.
CROSS SECTION EVALUATION CENTER. EVALUATION OF THE NEUTRON CROSS SECTION OF MANGANESE FOR THE ENDF/B LIBRARY
T. Stephenson, A. Prince, and S. Pearlstein Jun. 1967 54 p refs Sponsored by AEC
(BNL-50060) CFSTI: HC $3.00/MF $0.65

The evaluation of ^{55}Mn data for inclusion in the ENDF/B library is outlined, and a complete listing of the data in the ENDF/B format is presented. NSA

N68-16944# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.
SPONTANEOUS EMISSION IN THE PRESENCE OF A PRESCRIBED CLASSICAL FIELD
M. C. Newstein *In its* Microwave Res. Inst. Programs Nov. 1967 p 72–75 refs (See N68-16927 07-10)
(Grant NSF GU-1557)

A spontaneous emission model of two-level atoms interacting with a relaxation mechanism is used to investigate theoretically the spectral distribution from a system of atoms subjected to a strong, near resonant field. Assumed is a sufficiently large driving field where the treating Hamiltonian includes separate terms which describe the interactions of the atomic current with the prescribed classical field and with a small quantum-mechanical field. The spectral distribution of the spontaneous emission is computed to the second order in the small interaction so that the general solution gives the spectral power radiated in terms of the characteristic frequencies that describe the atomic and relaxation-mechanism parameters. Results show that the single Lorentzian line shape is split into components by the driving field, and that the relaxation mechanism tends to equalize the populations of the two levels. G.G.

N68-16945# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.
THE STOKES OPERATORS AND PHOTON CORRELATION FUNCTIONS
P. P. Bertrand, A. Kestenbaum, M. M. Miller, E. A. Mishkin, and D. Stoller *In its* Microwave Res. Inst. Programs Nov. 1967 p 76–77 refs (See N68-16927 07-10)
(Contract N00014-67-A-0438-0001)

The statistical properties of the electromagnetic field, coincidence experiments, state of polarization, and coherence characteristics are studied with a set of correlation functions that can be expressed in terms of the Stokes operators which are the quantum mechanical analogue of the classical Stokes parameters. A three dimensional representation of SU(2) and a second order quantum correlation function was derived in terms of the Stokes operator for a photon propagated along two component spinors and polarized in perpendicular directions. G.G.

N68-16997# Ludwig-Maximilians-Universitat, Munich (West Germany).
POLARIZATION OF COHERENT BREMSSTRAHLUNG BY EXTREMELY RELATIVISTICALLY POLARIZED ELECTRONS [POLARISATION DER KOHAERENTEN BREMSSTRAHLUNG VON EXTREMRELATIVISTISCHEN POLARISIERTEN ELEKTRONEN]
Berthold Neumcke 1967 58 p refs In GERMAN; ENGLISH summary
(NP-17173)

If unpolarized extreme relativistic electrons strike a single crystal, the spectrum of the arising bremsstrahlung has high-intensity peaks and the entire bremsstrahlung in these peaks is transversally polarized with respect to a crystal plane. The present calculations show that the bremsstrahlung of longitudinally polarized electrons from an amorphous target as well as from a crystal has the same circular polarization at all photon energies. Therefore intensive high-energy circularly polarized α rays are obtainable by coherent bremsstrahlung. No additional circular photon polarization arises from deceleration of transversally polarized electrons in a crystal. A possibility of a measurement of the longitudinal polarization of extreme relativistic electrons by using the coherent bremsstrahlung is discussed. As the usual methods leave much to be desired at these energies, one may transfer the longitudinal electron polarization by coherent bremsstrahlung to a circular photon polarization and convert it by another crystal into a transversal photon polarization. This polarization is then measurable with good accuracy by asymmetries in pair production. Author (NSA)

N68-17016# Naval Radiological Defense Lab., San Francisco, Calif.
MEASUREMENT OF POSITRON ANNIHILATION INTERACTIONS WITH A Ge(Li) DETECTOR
Henry P. Hotz, James M. Mathiesen, and John P. Hurley 16 Oct. 1967 29 p refs
(USNRDL-TR-67-127; AD-663113)

It was observed that the annihilation radiation photopeak in a Ge(Li) detector is considerably broader than that of a gamma-ray of the same energy. It seems reasonable to assume that the increased width is the result of the Doppler broadening of the annihilation photopeak, i.e., the longitudinal Doppler shift of the radiations is measured, while the transverse shift is measured in the usual angular correlation experiments. By using a computer stripping program to remove the distortion produced by the finite energy resolution of the detector, momentum distributions are obtained which are in agreement with those which have been published. Only one detector is necessary for these measurements and all moments channels are detected at once. However detector energy resolution severely limits the momentum resolution. Arguments are presented which indicate that no very large improvement in Ge(Li) detector resolution can be expected. Author (TAB)

N68-17017# Naval Radiological Defense Lab., San Francisco, Calif.

ANGULAR DISTRIBUTIONS OF GAMMA RAYS FROM (n,n γ) INTERACTIONS OF 2.8 MeV NEUTRONS WITH SODIUM, MAGNESIUM, ALUMINUM, SULFUR AND CHLORINE

W. E. Thompson, F. C. Engesser, and J. M. Ferguson 4 Oct. 1967 40 p refs

(USNRDL-TR-61-123; AD-663112)

The differential production cross sections for ten gamma rays resulting from the n,n gamma reaction of 2.8 MeV neutrons with the nuclei of Na, Mg, Al, S, and Cl were measured. Although measurements of some of these cross sections at 90 deg have been reported previously, the newly acquired angular mobility of the neutron generator made possible the extension of these measurements to other angles. These resulting angular distributions were also calculated using Satchlers formalism adapted to Moldauers modification of Hauser-Feshbach theory, using the transmission coefficients of Perey and Buck. Each distribution was calculated using two values of Moldauers parameter Q. The theoretical variations with angle of the gamma-ray production cross sections is reproduced from the computer-output graphs. The present experimental results obtained at 90 deg, 70 deg, 55 deg, and 31 deg are plotted on these graphs along with the results of others where they are available. Author (TAB)

N68-17054# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.

NUCLEAR PROBE MICROANALYSIS OF CARBON IN STEEL: AN EXPERIMENTAL STUDY OF THE APPLICABILITY OF THE $C^{13}(p, \alpha)N^{14}$ AND $C^{12}(p, \alpha)N^{13}$ REACTIONS

G. M. Padawer Dec. 1967 22 p refs

(RM-400)

Reported herein are experiments that were performed to ascertain the usefulness of two (p, γ) reactions as vehicles for probing the carbon content of steel surfaces. The 1.75-MeV resonance of the $C^{13}(p, \gamma)N^{14}$ reaction was found to be unusable because of irreducible beam-dependent background radiation originating within the target and beam-transport system. It was concluded that, with suitable shielding of the detector, the 0.45-MeV resonance of the $C^{12}(p, \gamma)N^{13}$ reaction should be useful for carbon microanalysis. Author

N68-17056# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).

THE STATISTICAL DESCRIPTION OF HIGH ENERGY MANY PARTICLE PRODUCTION REACTIONS [UEBER DIE STATISTISCHE BESCHREIBUNG HOCHENERGETISCHER VIELTEILCHENERZEUGUNGS-REAKTIONEN]

Helmut Satz Jul. 1967 69 p refs In GERMAN; ENGLISH summary

(DESY-67/25)

The description of many-particle production processes by means of statistical models is investigated, with particular attention paid to the inclusion of angular momentum conservation in addition to that of energy and momentum. The classical and quantum-mechanical phase space is formulated with full kinematics (all ten additive conservation laws) and its evaluation using the central limit theorem of statistics is discussed. The corresponding extension of the (Fermi) statistical model is carried out; the model thus obtained is then applied to find predictions about integral and differential quantities both for inelastic and for the coupled elastic reactions. Finally the general limits and possibilities of a statistical treatment of production reactions are discussed. Author (NSA)

N68-17057# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).

CONDITIONS ON DENSITY MATRIX ELEMENTS AND THEIR APPLICATION IN RESONANCE PRODUCTION

Jamil Daboul Aug. 1967 15 p refs

(DESY-67/28)

Model-independent upper bounds on the off-diagonal elements of the density matrices are obtained. They follow simply from a geometrical interpretation of these quantities. Author (NSA)

N68-17059# California Univ., Berkeley. Lawrence Radiation Lab.

DETERMINATION OF Y_4 DEFORMATIONS IN THE RARE EARTH REGION BY INELASTIC ALPHA PARTICLE SCATTERING

D. L. Hendrie, N. K. Glendenning, B. G. Harvey, O. N. Jarvis, H. H. Duhm et al Sep. 1967 21 p refs Presented at Intern. Conf. on Nucl. Struct., Tokyo, 7–13 Sep. 1967

(Contract W-7405-ENG-48)

(UCRL-17547(EXP); CONF-670910-5) CFSTI: HC $3.00/MF $0.65

The angular distributions of scattered alpha particles exciting members of the rotational band built on the ground state of even–even rare earth nuclei were measured. The results were compared with a theory that solves the scattering problem exactly if one assumes that the interaction can be represented by an optical potential of rigid deformed shape. The detailed agreement between theory and experiment yields for the first time accurate measurements of higher-order deformations in these permanently deformed nuclei. NSA

N68-17096*# National Bureau of Standards, Boulder, Colo. Cryogenics Div.

ON THE SELECTION OF THE INTERMOLECULAR POTENTIAL FUNCTION: APPLICATION OF STATISTICAL MECHANICAL THEORY TO EXPERIMENT

H. J. M. Hanley and Max Klein (Natl. Bur. of Std., Washington, D. C.) 20 Nov. 1967 89 p refs

(NASA Order R-06-006-046)

(NASA-CR-93126; NBS-TN-360) GPO: $0.50 CSCL 20H

We have developed a method here to evaluate quantitatively the relationship between model intermolecular potential functions and macroscopic experimental properties. Specifically, we have studied the function families: m-6, Kihara, exp- 6, and Morse, and the properties: viscosity coefficient, diffusion coefficient, second virial, and Joule–Thomson coefficient. The principal conclusions from this work are: (1) A temperature range exists in which data are completely insensitive to the potential function. This range makes it possible to quantitatively define what is meant by "high" or "low" temperatures. These definitions are most important when extrapolation of data arises. (2) The function families studied are

essentially equivalent. (3) More than one function is required to represent data over a range of about 1000°K. (4) We have estimated the experimental error which can be tolerated if experimental data are to be used to select a potential function. The conclusions are experimentally verified for both transport and equilibrium properties. Author

N68-17100*# Oak Ridge National Lab., Tenn. Neutron Physics Div.

NCDATA—NUCLEAR COLLISION DATA FOR NUCLEON–NUCLEUS COLLISIONS IN THE ENERGY RANGE 25 TO 400 MeV

R. G. Alsmiller, Jr. and J. Barish (Union Carbide Corp., Oak Ridge, Tenn.) Feb. 1968 32 p refs

(NASA Order R-104(1); NASA Order R-104(10); Contract W-7405-ENG-26)

(NASA-CR-93127; ORNL-4220) CFSTI: HC $3.00/MF $0.65 CSCL 20H

A computer code written in FORTRAN IV is described which interpolates between analytic fits to intranuclear-cascade data and gives for either neutrons or protons, in the energy range 25 to 400 MeV, incident on a nucleus of atomic weight A (between 12 and 238): (1) the nonelastic cross section as a function of energy; (2) the cascade neutron- and proton-emission spectra in the angular intervals 0–30°, 30–60°, 60–90°, and 90–180°; (3) the evaporation neutron- and proton-emission spectra (assumed isotropic), and (4) the cascade neutron- and proton-emission spectra integrated over all angles. In addition to numerical values for each of these quantities, the code also gives the values of the coefficients that occur in an analytic expression for each of these quantities. Author

N68-17111# Oak Ridge National Lab., Tenn.

ELASTIC AND INELASTIC SCATTERING OF 11.0-MeV PROTONS FROM ^{48}Ti, ^{51}V, ^{52}Cr, ^{54}Fe, ^{56}Fe, ^{59}Co, ^{60}Ni, ^{62}Ni, ^{64}Ni, ^{63}Cu, ^{65}Cu, ^{64}Zn, ^{66}Zn, AND ^{68}Zn: TABULATED DIFFERENTIAL CROSS SECTIONS

J. K. Dickens, F. G. Perey, and R. J. Silva Nov. 1967 117 p refs

(Contract W-7405-ENG-26)

(ORNL-4182) CFSTI: HC $3.00/MF $0.65

Numerical values of differential cross sections for elastic and inelastic scattering of 11.0-MeV protons from ^{48}Ti, ^{51}V, ^{52}Cr, ^{54}Fe, ^{56}Fe, ^{59}Co, ^{60}Ni, ^{62}Ni, ^{64}Ni, ^{63}Cu, ^{65}Cu, ^{64}Zn, ^{66}Zn, and ^{68}Zn are reported in tabular form. Cross sections were determined at 5° intervals between laboratory angles of 20 and 164°. Inelastic scattering data are reported for 8 excited states of ^{48}Ti, 7 excited states of ^{51}V, 21 excited states of ^{52}Cr, 9 excited states of ^{59}Co, 13 excited states of ^{60}Ni, 10 excited states of ^{62}Ni, 9 excited states of ^{64}Ni, 10 excited states of ^{63}Cu, 5 excited states of ^{65}Cu, 5 excited states of ^{64}Zn, 6 excited states of ^{66}Zn, and 6 excited states of ^{68}Zn. Author (NSA)

N68-17117# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.

MEASUREMENTS OF THE ANGULAR DISTRIBUTIONS OF PARTICLES GENERATED IN NUCLEAR INTERACTIONS REGISTERED IN NUCLEAR EMULSIONS [POMIAR ROZKLADU KATOWEGO CZASTEK GENEROWANYCH W ODDZIALYWANIACH JADROWYCH ZAREJESTROWANYCH W KLISZACH]

T. Coghen, Z. Czachowska, A. Jurak, S. Krzywdziwski, K. Rybicki et al 1967 35 p in POLISH; ENGLISH summary

(INR-794/6/PH)

A procedure for measurement of the angular distribution of particles produced in nuclear interactions registered in nuclear emulsion is presented. Special attention was made to the measurements of small angles ($\leq$1 mr) which are present in high energy ($\geq$1 TeV) interactions. Author (NSA)

N68-17120# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.

ENERGY DISTRIBUTION OF LONG RANGE α PARTICLES EMITTED DURING THE THERMAL NEUTRON FISSION OF ^{235}U

M. Sowinski, J. Chwaszczewska, M. Dakowski, A. Gadomski, T. Krogulski et al 1967 16 p refs Submitted for publication

(INR-817/1A/PL)

The energy spectrum of the long range α particles emitted in the thermal neutron fission process of ^{235}U was measured. A good fit was found using the Gaussian distribution. The relative cross section for thermal and resonance neutrons was determined. An attempt to estimate the yields of the other charged particles emitted in the ternary fission was made. Author (NSA)

N68-17121# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.

AN ANALYSIS OF NUCLEAR INTERACTIONS OF ENERGIES $\geq 10^{12}$ eV [ANALIZ FOTOMEUL'SIONNYKH DANNYKH O YADERNYKH VEAIMODEISTVIYAKH S ENERGIYAMI $\geq 10^{12}$ eV]

M. Mensovich and E. Gerulya [1967] 25 p refs In RUSSIAN; ENGLISH summary

(INR-813/6/PH)

Results of an analysis of interactions between nucleons of energies higher than 10^{12} eV and emulsion nuclei in two large emulsion stacks are presented. The main results of the emulsion work are presented from the point of view of the fireball model taking into account the possibility of the excitation of the nucleons. Author (NSA)

N68-17124# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.

AN ATTEMPT TO DETERMINE VAN HOVE'S OVERLAP FUNCTION AND SHADOW ELASTIC SCATTERING FROM THE MEASUREMENTS OF INELASTIC π^+p INTERACTIONS AT 8 GeV/c [PROBA WYZNACZENIA FUNKCJI PRZEKHYWANIA VAN HOVE'A I CIENIOWEGO ROZPRASZANIA ELASTYCZNEGO NA PODSTAWIE POMIAROW NIEELASTYCZNYCH ODDZIALYWAN π^+p PRZY PEDZIE 8 GeV/c]

Lech Michejda 1967 39 p refs

(INR-825/6/PH)

From the measurement of π^+p inelastic reactions at 8 GeV/c the Van Hove overlap function is determined assuming no correlations among secondary particles, a constant phase of the wave function and neglecting spins. The overlap functions obtained for various channels are used to compare how much peripheral or central are these collisions. It was found that the computed overall overlap function violated unitarity bounds on partial inelastic cross sections G^J_{in} and is in striking disagreement with the G^J_{in} estimated from the inelastic differential cross section. It seems that the failure of the calculation is mainly due to the incorrect assumption that the phase of the many-body wave function does not depend on the momentum configuration of the final-state particles. Author (NSA)

N68-17127# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.

ABSOLUTE MEASUREMENT ON THE LONGITUDINAL POLARIZATION OF BETA RAYS FROM ISOTOPES: ^{46}Sc, ^{137}Cs AND ^{204}Tl [BEZWZGLEDNY POMIAR PODLUZNEJ POLARYZACJI ELEKTRONOW EMITOWANYCH W ROZPADZIE BETA IZOTOPOW: ^{46}Sc, ^{137}Cs I ^{204}Tl]

1967 15 p refs In RUSSIAN; ENGLISH summary
(Rept.-798/I/PL) CFSTI: HC $3.00/MF $0.65

The longitudinal polarization electrons from beta-decay of isotopes: ^{46}Sc, ^{137}Cs and ^{204}Tl were compared. The degree of polarization was measured by the asymmetry in the electron scattering in a thin gold foil. Longitudinal electron polarization was transformed into transverse polarization by means of crossed electric and magnetic fields. The measurements were carried out for the electrons of energy: E_e = 250 keV. The results for the longitudinal polarization are as follows: ^{46}Sc: – 0.908 v/c ± 3.2%, ^{137}Cs: – 0.930 v/c ± 3.3% and ^{204}Tl: – 1.003 v/c ± 2.8%. v/c ± 2.8%. Author

N68-17128# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.

ON THE DECAY OF ^{158}Ho [O SKEME RASPADA ^{158}Ho]

A. A. Abdurazakov, Ya. Vrzal, K. Ya. Gromov, Zh. T. Zhelev, V. G. Kalinnikov et al 1967 28 p refs In RUSSIAN
(JINR-P6-3464)

The γ spectra were investigated using a Ge(Li) γ spectrometer, and the conversion-electron spectra in β^+ decay of ^{158} + ^{158m}Ho were measured using a magnetic spectrometer. More than 100 previously unreported γ lines and three components of the β^+ decay (1300±30; 1850±25; 2890±20 keV) were detected. The existence of a double quasi-particle level at 1895 keV of the type (4^+) n 5/2$^-$ (523) + n 3/2$^-$ (521) was shown. Conclusions were made on the quantum character of the ground state of ^{158}Ho(5+). The experimental and theoretical ratios of the reduced probability of E2 transition of ^{158}Dy between bands with $Z^\pi = 2^+$ and $K^\pi = 0^+$ were compared. Vibrational bands of 986.1 keV (0^+) and 1085 keV (2^+) were proposed. More than 20 previously unreported levels were proposed in the decay scheme of $^{158+158m}$Ho. Data were given on the population of the levels of ^{158}Dy. The mass difference of the nuclides ^{158}Ho and ^{158}Dy was determined to be 4220±30 keV. A decay scheme for $^{158+158m}$Ho was discussed. Author (NSA)

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N68-16157# Institut Franco-Allemand de Recherches, St. Louis (France).

HYPERFREQUENCY DIAGNOSIS OF A BOUNDARY PLASMA BY DIELECTRIC WALLS [DIAGNOSTIC HYPERFREQUENCE D'UN PLASMA LIMITE PAR DES PAROIS EN DIELECTRIQUE]

8 Jun. 1966 61 p refs In FRENCH
(Contract DTE-66.70.147.00.480.75.01)
(ISL-T-12/66)

Quotient-difference algorithms are developed to correlate wave phase transformations and wave damping in an unlimited plasma with interferometric measurements on damping and phase transmissions. Differences in measurements are attributed to the multiple plasma reflectivity and the dielectric field around the plasma. Also discussed is a numerical computation that uses the measured phase tranamission values to obtain the plasma velocity mass values. Both problems are programmed in Fortran. Author

N68-16171# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.

STUDY OF THE INJECTION OF PLASMA INTO A MAGNETIC FIELD OF DOUBLE CURVATURE GEOMETRY [ETUDE DE L'INJECTION DE PLASMA DANS UN CHAMP MAGNETIQUE A DOUBLE COURBURE]

Jacques Lasry (Ph.D. Thesis—Paris Univ., Orsay, France) 1967 110 p refs In FRENCH
(CEA-R-3278; EUR-3529F)

A hydrogen plasma is injected along the lines of a magnetic field with a double-curvature geometry. The plasma is produced by a coaxial gun with an annular pre-ionization system. It is shown theoretically that the electric drift of the plasma can be cancelled if a depolarizing current flows along the field lines towards a region of good transverse conductivity. The experiment shows that in these conditions the curvature drift of the ions of the plasma may be used as a very efficient process to purify the fast component of the plasma. The depolarizing electron currents are measured and the mutual cancellation of the electric fields developing into the oppositely curved region is demonstrated to be possible. The current densities agree with the values deduced of the curvature drift of the ions. Author (NSA)

N68-16179# California Univ., Livermore. Lawrence Radiation Lab.

STUDY OF INSTABILITIES IN THERMALLY IONIZED PLASMA [ISSLEDOVANIYE NEUSTOYCHIVOSTEV V TERMICHESKI IONNIZIROVANNOY PLAZME]

N. S. Buchel'nikova Oct. 1967 34 p refs Transl. into ENGLISH from Russian Preprint
(UCRL-TRANS-10142) CFSTI: HC $3.00/MF $0.65

A number of instabilities were investigated in thermally ionized plasma which is a convenient object for studying the plasma properties. The first class of instabilities to be investigated was concerned with dense inhomogeneous plasma. The drift-dissipative instability was observed and investigated in detail in collisional plasma in which the Larmor radius of ions ρ_i was much smaller than the linear dimensions R of the system. A state akin to drift instability was also found in collisionless plasma for $\rho_i < R$. As the ratio ρ_i/R approaches a figure greater than or comparable with unity, this instability is transformed into the instability of highly inhomogeneous plasma which gives rise to azimuthal waves whose phase velocities are equal to the velocity of ion-acoustic waves. Oblique waves for which the phase velocity of the longitudinal components approaches the velocity of ion-acoustic waves are excited in the case of low density gradients. Author (NSA)

N68-16201# Aeronautical Research Associates of Princeton, Inc., N. J.

THE KINETIC THEORY OF A PLASMA IN THE PRESENCE OF STRONG MAGNETIC FIELDS. 2: LOWEST ORDER CORRECTIONS

S. Radin, Arnold H. Kritz, and G. Sandri Wright-Patterson AFB, Ohio ARL Jul. 1967 49 p refs
(Contract AF 33(615)-1910)
(ARL-67-0158; AD-659745)

Utilizing a recent result on the two-particle correlation function for a plasma in a strong magnetic field, a kinetic description is obtained for such a plasma in terms of the single electron distribution function. The effects are calculated of the magnetic field on the collision integral up to second order in the field strength. The description is valid for magnetic fields (in gauss) up to about 0.001 (n/cc) to the 1/2 power), where n is the number density of electrons. The results are in a form suitable for calculating transport coefficients. Author (TAB)

N68-16223# Stevens Inst. of Tech., Hoboken, N. J. Dept. of Physics.
GRAPHICAL COMPILATION OF CHARACTERISTIC QUANTITIES FOR CESIUM, POTASSIUM, AND BARIUM PLASMAS
William W. Destler Aug. 1967 33 p
(Contract AT(30-1)-2813)
(SIT-2813-42; SIT-206) CFSTI: HC $3.00/MF $0.65

Ion cyclotron frequencies, drift velocities, Larmor radii, electron–ion and ion–ion collision frequencies, Debye lengths, and plasma frequencies have been calculated for a wide range of temperatures, magnetic fields, and ion densities. For the most part, the graphs offer values for almost all reasonable parameters. Included also is a complete list of expressions and values used in the calculations. NSA

N68-16230# Oxford Univ. (England). Dept. of Engineering Science.
SOME PROBLEMS IN PLASMA PHYSICS
Donald H. McKay (Ph.D. Thesis) Mar. 1967 97 p refs
(Contract AF 61(052)-734)
(AFOSR-67-1478; AD-654258)

The thesis contains the results of some research on electromagnetic wave propagation in bounded plasmas. The first part of the work is on compressional magnetohydrodynamic waves whose frequencies are close to the plasma ion cyclotron frequency. The waves propagate along inhomogeneous plasma cylinders in which the densities vary with radius. The next part of the thesis is concerned with wave propagation of a more general type: it is assumed that notion of the medium may be represented by a dielectric matrix, but the matrix and the wave mode are not specified in detail. The cylindrical medium is homogeneous. Expressions describing the wave motion are derived, and some properties of the solutions are discussed. A computer program related to the solutions is obtained. The remainder of the thesis is on some types of electron waves. Author (TAB)

N68-16242# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
RETROGRADE CATHODE SPOT BEHAVIOR IN LOW DENSITY ARCS
S. F. Giannotta Sep. 1967 35 p ref Submitted for publication
(ARL-67-0194; AD-663214)

In a low pressure arc discharge, simultaneous cathode spots are observed on a cold-cathode, copper plate electrode. These spots circle the plate in the -I X B direction. The number of spots and the patterns of movement change as functions of the pressure and the applied magnetic field. Since multispots exist, corrections are applied to find the effective magnetic field acting on the ith spot. For observed spot sizes and separations, it is found that the self-magnetic field is of the same order of magnitude as the applied field. Author (TAB)

N68-16244# Stanford Univ., Calif. Inst. for Plasma Research.
CYCLOTRON HARMONIC WAVE PHENOMENA IN PLASMAS
F. W. Crawford Jul. 1967 30 p refs Presented at the 8th Intern. Conf. on Phenomena in Ionized Gases, Vienna
(Contract AT(04-3)-326)
(SU-IPR-189; CONF-670810-5) CFSTI: HC $3.00/MF $0.65

A review is presented of the correspondence between the theoretical and experimental activities in the field. The most significant result of the work is that, since the CHW propagation is predicted only by microscopic theory based on the Boltzmann equation, the close agreement between theory and experiment adds considerably to our confidence in the mathematical procedures governing the description of warm magnetoplasma wave and instability properties. The results complement those on Landau damping obtained under conditions where magnetic field effects are unimportant. NSA

N68-16253# Royal Inst. of Tech., Stockholm (Sweden). Div. of Plasma Physics.
ON THE BALANCE OF A MAGNETIZED PLASMA
Bo Lehnert 4 Dec. 1967 109 p refs Supersedes Rept.-66-17; Rept.-66-19 See N67-22496; N67-21766
(Rept.-67-26; Rept.-66-17; Rept.-66-13) CFSTI: HC $3.00/MF $0.65

This paper forms an extension of earlier investigations on the particle, momentum and heat balance of a partially ionized plasma where the effects of collisions and ionization are included. In particular, static and rotating, fully ionized plasmas are studied which are surrounded by boundary regions containing neutral gas which penetrates into the plasma to a certain depth. Diagnostical methods for the determination of the plasma temperature are important in the experimental study of the heat balance. Finally, a method is discussed which is based on the damping of free radial oscillations which becomes a measure of the resistivity. ESRO

N68-16283# Czechoslovak Academy of Sciences, Prague.
EFFECT OF MULTIPLE REFLECTIONS ON THE ACCURACY OF MICROWAVE-INTERFEROMETER MEASUREMENTS OF THE PLASMA-ELECTRON DENSITY
J. Musil and F. Zacek Dec. 1966 10 p
(IPPCZ-70)

An analysis is presented of the oscillatory character of the electron density variations as a function of the position of the receiving antenna relative to the axis of the plasma cylinder. The study deals with the following two cases: the plasma cylinder diameter D is far larger than the wave length, $D >> \lambda$ and the diameter of plasma is comparable to the wave length $D \approx \lambda$. In the first case, the calculation starts from the plane slab approximation of the plasma, in the second from the scattering of the incident plane wave by the plasma. Author (NSA)

N68-16284*# State Univ. of Iowa, Iowa City. Physics and Astronomy Dept.
PLASMA PHYSICS ABSTRACTS, 1 JANUARY 1966 THROUGH 31 DECEMBER 1967
David C. Montgomery and Donald A. Gurnett 31 Dec. 1967 14 p refs
(Grant NGR-16-001-043)
(NASA-CR-91239) CFSTI: HC $3.00/MF $0.65 CSCL 20I

This bibliography consists of 28 recent references, most of them with abstracts. These references represent plasma physics publications from the University of Iowa during the above period which are considered relevant to research conducted within a NASA program. K.W.

N68-16285# Royal Inst. of Tech., Stockholm (Sweden). Electron and Plasma Physics Div.
UPSTREAM WAKES IN MAGNETOHYDRODYNAMIC FLOW
Ulf Fahleson 27 Nov. 1967 44 p refs
(Rept.-67-25) CFSTI: HC $3.00/MF $0.65

Ten years after the first description of an upstream disturbance in a magnetohydrodynamic flow it can be stated that a rather good theoretical understanding of the phenomenon has been achieved. In general, agreement exists between different theorists and also

between theory and the scarce experiments that have been made. The singular and very unphysical case of steady, nondissipative flow forms an exception. The disagreement in this case mainly is one of boundary conditions, a closer (experimental and theoretical) study of magnetohydrodynamic boundary layers may clarify this problem as well as the yet unsettled problem of the stability of the wakes. Author (ESRO)

N68-16286*# National Aeronautics and Space Administration, Washington, D. C.

MOTION OF CONDUCTING BODIES IN A MAGNETIC FIELD

Ya. Ya. Liyelpeter, ed. Feb. 1968 152 p refs Transl. into ENGLISH of the book "Dvizheniye Provodyashchikh Tel v Magnitnom Pole" Riga, Izd. Zinatne, 1966
(NASA-TT-F-460) CFSTI: HC $3.00/MF $0.65 CSCL 20I

CONTENTS:

1. STATE OF THE THEORY OF MAGNETOHYDODYNAMIC INDUCTION MACHINES WITH WORKING MEDIA OF LIQUID METAL Ya. Ya. Liyelpeter p 1–12 refs (See N68-16287 07-25)

2. ELECTROMAGNETIC PROCESSES IN AN IDEAL INDUCTION MHD MACHINE A. K. Veze and L. Ya. Ulmanis p 13–37 refs (See N68-16288 07-25)

3. HIGHER SPATIAL HARMONICS OF THE MAGNETIC FIELD OF AN INDUCTION MHD MACHINE Yu. Ya. Mikel'son p 38–57 refs (See N68-16289 07-25)

4. TRANSVERSE EDGE EFFECT IN PLANE INDUCTION MAGNETOHYDRODYNAMIC MACHINES A. Ya. Vilnitis p 58–85 refs (See N68-16290 07-25)

5. LONGITUDINAL EDGE EFFECT IN LINEAR INDUCTION MHD MACHINES Ya. Ya. Valdmanis p 85–98 refs (See N68-16291 07-25)

6. PONDEROMOTIVE FORCES ACTING UPON CONDUCTIVE BODIES IN THE TRAVELING MAGNETIC FIELD OF A CYLINDRICAL INDUCTOR Yu. K. Krumin' p 99–121 refs (See N68-16292 07-25)

7. THEORY FOR THE PROPAGATION OF PULSED ELECTROMAGNETIC FIELDS IN MOVING CONDUCTIVE MEDIA G. Ya. Sermons p 121–147 refs (See N68-16293 07-25)

N68-16287*# National Aeronautics and Space Administration, Washington, D. C.

STATE OF THE THEORY OF MAGNETOHYDRODYNAMIC INDUCTION MACHINES WITH WORKING MEDIA OF LIQUID METAL

Ya. Ya. Liyelpeter *In its* Motion of Conducting Bodies in a Magnetic Field Feb. 1968 p 1–12 refs (See N68-16286 07-25)

Survey information is presented on the theory of magnetohydrodynamic (MHD) induction machines, with particular reference to analyzing the properties of a set of structural diagrams at preset specific loads and geometrical dimensions. The state of MHD induction machine electromagnetic theory is examined in some detail; this theory comprises the study of electromagnetic field structure in the working gap of the machine, as well as of processes in the magnetic and electrical circuits which determine the effective resistance and reactance of the windings. Also reviewed are studies pertaining to the plane linear MHD machine; the transverse edge effect in a plane MHD induction machine; magnetic field structure of an inductor of finite length; the theory of cylindrical MHD induction machines; and the motion of conducting bodies in pulsed electromagnetic fields. A reference bibliography is included. M.G.J.

N68-16288*# National Aeronautics and Space Administration, Washington, D. C.

ELECTROMAGNETIC PROCESSES IN AN IDEAL INDUCTION MHD MACHINE

A. K. Veze and L. Ya. Ulmanis *In its* Motion of Conducting Bodies in a Magnetic Field Feb. 1968 p 13–37 refs (See N68-16286 07-25)

A summary is presented on the solutions for electromagnetic processes in a conductive band located in a traveling magnetic field of a flat inductor. It is assumed that the dimensions of the device are infinite in the direction of motion of the field and in the direction in which the electric current passes. Author

N68-16289*# National Aeonautics and Space Administration, Washington, D. C.

HIGHER SPATIAL HARMONICS OF THE MAGNETIC FIELD OF AN INDUCTION MHD MACHINE

Yu. Ya. Mikel'son *In its* Motion of Conducting Bodies in a Magnetic Field Feb. 1968 p 38–57 refs (See N68-16286 07-25)

Certain similarities between problems involved in the theory of asynchronous engines and induction magnetohydrodynamic (MHD) machines are noted, and the factors causing the deviation of the traveling magnetic field from a sinusoidal one are identified. Studies on higher spatial harmonics (HSH) are surveyed, and the results are given of investigations pertaining to the harmonics produced due to the spatial distribution of the multiphase stator winding, and their influence upon the motion of the rotor. Emphasis is placed on theoretical computations of HSH from the spatial distribution of the winding with a smooth steel surface of the stator; and the influence of an inductor surface having projections on the electromagnetic field distribution in a conductive band. Analytical computations are presented which may be used to obtain the coefficients for determining the distribution of the electromagnetic field, the force density, and Joule heat losses in the channel of an induction MHD machine. A reference bibliography is included. M.G.J.

N68-16290*# National Aeronautics and Space Administration, Washington, D. C.

TRANSVERSE EDGE EFFECT IN PLANE INDUCTION MAGNETOHYDRODYNAMIC MACHINES

A. Ya. Vilnitis *In its* Motion of Conducting Bodies in a Magnetic Field Feb. 1968 p 58–85 refs (See N68-16286 07-25)

The problem is formulated for the general case of a plane induction magnetohydrodynamic machine consisting of two plane stators (inductors) with m-phase winding, a plane channal with molten metal, and a thermal insulation channel. The factors influencing the transverse edge effect are described, and the theories and mathematical methods used in the computations are assessed. Solutions are given for infinitely wide model systems. An analysis is presented of the transverse edge effect in pure form, i.e., when there is no attenuation of the field in the clearance, which is achieved in the limit by the thin clearance between the inductors. Other theories pertaining to plane-parallel field in the clearance of the machine are reviewed. Consideration is also given to the transverse edge effect in induction pumps relative to the transition from an extremely thin plate between the inductors to a plate of finite thickness. A reference bibliography is included. M.G.J.

N68-16291*# National Aeronautics and Space Administration, Washington, D. C.

LONGITUDINAL EDGE EFFECT IN LINEAR INDUCTION MHD MACHINES

Ya. Ya. Valdmanis *In its* Motion of Conducting Bodies in a Magnetic Field Feb. 1968 p 85–98 refs (See N68-16286 07-25)

A state-of-the-art survey is presented on research in connection with the longitudinal edge effect in magnetohydrodynamic (MHD) machines. Allowance is made for their specific properties, such as an unlimited secondary circuit, and a practically infinite magnetic permeability of the magnetic circuit. It is assumed that the channel of molten metal is infinite, and the longitudinal effect is related to the finiteness of the inductor which is represented by a smooth magnetic circuit (in theoretical computations) with linear current loading given on its surface in the form of a traveling wave. Only the electrodynamic portion of the computation is investigated in each report considered, i.e., the molten metal of the secondary circuit is replaced by a solid metal moving at a constant velocity. The results are obtained from a solution of the Maxwell equations, in differential or integral forms, with the corresponding boundary conditions. Attention is focused on studies pertaining to the magnetic field of a finite inductor (longitudinal edge effect in a primary circuit), and to the magnetic field of a finite inductor with a secondary circuit. M.G.J.

N68-16292*# National Aeronautics and Space Administration, Washington, D. C.

PONDEROMOTIVE FORCES ACTING UPON CONDUCTIVE BODIES IN THE TRAVELING MAGNETIC FIELD OF A CYLINDRICAL INDUCTOR

Yu. K. Krumin' *In its* Motion of Conducting Bodies in a Magnetic Field Feb. 1968 p 99–121 refs (See N68-16286 07-25)

Problems encountered in designing a device using ponderomotive forces, which influence the conductive media located in the traveling magnetic field, are surveyed. Particular reference is made to the progress achieved in developing methods for calculating these forces, particularly their maximum values, as a function of other characteristics of the device. The problem areas considered pertain to the cylindrical inductor and its electromagnetic field; solutions to the problem of a conductive medium with a certain configuration placed in the inductor, and the corresponding solutions for the ponderomotive forces; methods of representing the results; the solid conductive cylinder in the field of an ideal inductor; the hollow conductive cylinder in the field of an ideal inductor; the solid cylinder having finite length in the field of an ideal inductor; the conductive cylinder in the field of a real inductor; and the conductive sphere in the field of a cylindrical inductor. M.G.J.

N68-16293*# National Aeronautics and Space Administration, Washington, D. C.

THEORY FOR THE PROPAGATION OF PULSED ELECTROMAGNETIC FIELDS IN MOVING CONDUCTIVE MEDIA

G. Ya. Sermons *In its* Motion of Conducting Bodies in a Magnetic Field Feb. 1968 p 121–147 refs (See N68-16286 07-25)

A survey was conducted on the methods and results which may be directly applied to studying the propagation of pulsed fields in moving, electroconductive media. The phenomena investigated are limited to problems which include different solutions of the Maxwell equations for moving media. Consideration is also given to the most characteristic methods and results of solving the problem when there is no motion, i.e., the group of problems which include different solutions of the equations. M.G.J.

N68-16313# Czechoslovak Academy of Sciences, Prague. Inst. of Plasma Physics.

COMPLETE SPECTRUM OF FLUTE INSTABILITY AT LOW DENSITY

Z. Sedlacek Jan. 1967 15 p refs (IPPCZ-73)

With the plasma density profile of the tangens hyperbolicus form, the eigenvalue equation for the flute instability of a cold, rarefied plasma reduces to the hypergeometric differential equation for which the eigenvalue problem is exactly solvable. The dispersion relation thus obtained is valid for arbitrary relation of the wave number to the density gradient and covers not only the principal eigenmode but also all higher eigenmodes. The principal eigenmode turns out to be the most unstable; if it is stabilized, so are all higher eigenmodes. Author (NSA)

N68-16362*# Avco Corp., Lowell, Mass. Space Systems Div.

EXPERIMENTS TO ESTABLISH CURRENT-CARRYING CAPACITY OF THERMIONIC-EMITTING CATHODES Final Report, 11 Jan. 1966–30 Jan. 1967

Albert Tuchman and George Enos 30 Jan. 1967 73 p refs (Contract NAS2-3379)
(NASA-CR-73186; AVSSD-0043-67-RR) CFSTI: HC $3.00/MF $0.65 CSCL 20I

Data are presented on the current carrying capabilities of thermionic cathodes in nitrogen at pressure levels above one atmosphere. Experimental determinations were made of the maximum pressure level at which thermionic cathodes of different sizes, shapes, and compositions may be operated at fixed current levels before catastrophic erosion of the cathode material begins. Of greatest importance was the finding that additions of barium calcium aluminate have a definitely beneficial effect upon cathode performance. Secondly, the use of larger diameter cathode tips did not always improve the operating characteristics of cathodes. It was found that four 1/4-inch diameter cathode tips will carry more current than a single 1/2-inch tip (same cross-sectional area), but a 1/2-inch tip can carry more current than a 1-inch tip for certain operating conditions. C.T.C.

N68-16401# Observatoire de Paris (France).

EMISSION SPECTROSCOPY INVESTIGATIONS OF PARTIALLY IONIZED GASES

L. Herman [1967] 22 p
(Contract AF 61(052)-88)
(AD-663235)

Emission spectra were investigated in cases of partially ionized plasmas obtained under conditions of (1) low pressure - low current discharge, and of (2) high pressure - high current discharge. For plasmas of type (1) it was possible to show the importance of atomic recombination and molecular dissociation, of molecular excitation by metastable atoms, etc.; investigations of type (2) plasmas included radiative recombination, the process of Stark effect broadening, etc. TAB

N68-16443# Czechoslovak Academy of Sciences, Prague. Inst. of Plasma Physics.

EQUILIBRIUM CONFIGURATIONS OF PLASMA AND SELF-CONSISTENT FIELD WITH AXIAL SYMMETRY, PART 2

J. Lacina Mar. 1966 37 p refs (IPPCZ-64)

The equilibrium configuration of plasma (the stationary distribution function of charged particles) and of the self-consistent magnetic field is determined on the basis of the first integrals of motion. A detail analysis is made of the mutual relation between the function on the integrals of motion; the necessary and sufficient conditions which must be satisfied by the distribution function with minimum-B are obtained. Author (NSA)

N68-16449*# Miami Univ., Coral Gables, Fla. Dept. of Physics.
FIELD EMISSION OF CESIUM IONS
Nicholas Sama 1967 58 p refs Submitted for publication
(Grant NsG-621)
(NASA-CR-93003; MIAPH-PP-67.8) CFSTI: HC $3.00/MF $0.65 CSCL 20I

The field emission of cesium ions from a positive electrode is formulated for the range of electric field over which an image potential binds the ions to the electrode surface. Recent investigations on the ionization of gas atoms by a metal surface are utilized, in conjunction with steady-state arguments, to yield an expression for the ion supply at the electrode surface. A tunnelling process in the presence of an electric field is then considered, and the ion emission obtained in terms of fundamental constants and pertinent parameters. As part of the overall problem, the effect on the emission current of fractional adsorbed atomic layers on the electrode is examined; not surprisingly, the non-uniform properties of a real electrode lead to the same difficulties in the description of ion emission as those met in the case of electron field emission.
Author

N68-16455# Czechoslovak Academy of Sciences, Prague. Inst. of Plasma Physics.
A NOTE ON THE PROPAGATION OF RIGHT HAND AND LEFT HAND CIRCULARLY POLARIZED WAVES IN A MAGNETOACTIVE PLASMA IN THE NEIGHBOURHOOD OF CYCLOTRON FREQUENCIES
J. Musil and J. Teichmann Jan. 1967 11 p refs
(IPPCZ-74)

Properties of propagation of plane right-hand and left-hand circularly polarized waves in an unbounded magnetoactive plasma in the neighborhood of electron and ion cyclotron frequencies are discussed. The regions of temperatures of the electron and ion components of the plasma and of the plasma densities in which the waves propagate either with a very weak attenuation $\kappa << n$ or with a very strong attenuation $\kappa \approx n$ are deduced from the dispersion equation derived in the linear approximation. It is demonstrated that a left-hand circularly polarized wave does not propagate in a plasma with density $N \geq 4 \times 10^{14} H^2/T_i$.
Author (NSA)

N68-16456# Czechoslovak Academy of Sciences, Prague. Inst. of Plasma Physics.
ON THE STATIONARY STATE OF A PLASMA IN MAGNETOSTATIC AND POTENTIAL FIELDS, PART 2
R. Klima Jun. 1966 18 p refs
(IPPCZ-66)

The density distribution on the lines of force of the magnetostatic field is established under certain simplifying conditions for a plasma bounded by a combination of a magnetostatic and a potential field. The distribution functions of the particles, too, are determined for some of the cases being examined. It is found that certain nonlinear effects given by the action of the averaged high-frequency forces in the plasma can occur in experiments concerning the magnetoacoustic resonance of the plasma column.
Author (NSA)

N68-16457# California Inst. of Tech., Pasadena.
PLASMA ECHOES AT UPPER HYBRID RESONANCE
Luc O. Bauer, Fred A. Blum, and Roy W. Gould Dec. 1967 17 p refs
(Contract Nonr-220(50))
(TR-37; AD-663137)

Experimental observation of a new plasma echo at upper hybrid resonance is reported and a simple theoretical model which exhibits some major features of the results is presented.
Author (TAB)

N68-16507*# Pennsylvania State Univ., University Park. Dept. of Electrical Engineering.
TRAPPED MODES IN PLASMA SLABS AND CYLINDERS
A. J. Weil 1 Feb. 1968 143 p refs
(Grant NsG-134-61)
(NASA-CR-93148; SR-314) CFSTI: HC $3.00/MF $0.65 CSCL 20I

An analysis of trapped modes is given for uniform, cold magneto-plasma slabs and rods. The full set of Maxwell's equations is used, and arbitrary magnetic field strength is allowed. Two dispersion relations are obtained for the slab, characterizing symmetric and anti-symmetric field solutions. The general dispersion relation for the plasma rod geometry is obtained, simplified using an analogy with the slab case, and analyzed. For each dispersion relation, three kinds of interior waves are found: (1) waves which damp as you move toward the center; (2) oscillating or body waves; and (3) damped oscillating waves. The field characteristics of the waves are analyzed for the slab geometry and for the dipolar modes of the plasma rod. A new approximation, the "one wave" approximation is introduced and discussed. Dispersion curves and field solutions are given for $\Omega = .5\omega_p$ and $\Omega = 1.5\omega_p$, and for different thicknesses.
Author

N68-16525# Nagoya Univ. (Japan). Inst. of Plasma Physics.
PROPAGATION AND DAMPING OF LARGE-AMPLITUDE ION ACOUSTIC WAVES IN A PLASMA
Noriyoshi Sato (Tohoku Univ.), Hiroyuki Ikezi, Nobuo Takahashi, Yoshihiko Yamashita (Okayama Univ.), and Tokuhiro Obiki (Kyoto Univ.) Nov. 1967 10 p refs
(IPPJ-62) CFSTI: HC $3.00/MF $0.65

Finite amplitude effects on propagation and damping of ion acoustic waves are studied experimentally in a cesium plasma produced by surface ionization. For large-amplitude waves, the phase velocity is increased with the voltage of continuous sinusoidal signals for wave excitation, but does not depend on the local wave amplitude. The damping rate becomes large with the exciting voltage near the exciting grid. At a distant place, however, the wave damping is small compared with the linear Landau damping and is accompanied with a weak amplitude oscillation.
Author

N68-16527*# General Dynamics/Convair, San Diego, Calif.
ADDITIONAL DEVELOPMENT OF A PROBE TO MEASURE VELOCITY DISTRIBUTIONS IN THE EXHAUST OF STEADY STATE PLASMA ACCELERATORS Final Report
L. Liebing Nov. 1967 25 p refs
(Contract NAS1-7286)
(NASA-CR-66550; GD/C-DBE-67-022) CFSTI: HC $3.00/MF $0.65 CSCL 20I

The principle of peration of the probe, the mathematical treatment of the data, and the physical sources of error have been discussed in detail. This report presents those particular problems which are related to the probe's application in the MPD arc plasma and describes their solution. The result is a new probe with new measuring equipment. The velocity data is acquired through the measurement of the time-of-flight of the ions between an electrical plasma shutter and an ion collector.
Author

N68-16546# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.

MEASUREMENTS OF PROPERTIES OF PLASMA EJECTED FROM A COPPER COAXIAL RAIL GUN OPERATED IN A ZERO TO THREE-TENTHS TESLA AXIAL MAGNETIC FIELD

A. L. Lind and E. A. Valsamakis Jan. 1968 33 p refs

(RM-404)

The characteristics of the emergent copper plasma from a copper coaxial rail gun operated either in or out of an axial magnetic field were measured. The results in the absence of the magnetic field, and with the rail gun voltages ranging from 5 to 10 kV, indicate the ion densities vary from 2 to 60×10^{18} ions/m^3 and the ion speeds from 4 to 6×10^4 m/sec. When the axial magnetic field (0.1 to 0.3 Tesla) is used, the ion densities range from 60 to 330×10^{18} ions/m^3, the ion speeds from 5 to 9×10^4 m/sec, and the electron temperatures from 7 to 9 ev. In the presence of the axial magnetic guide field the plasma moves along a helical trajectory with angular speeds less than the ion cyclotron speeds. Author

N68-16599# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.

PLASMA CONFINEMENT WITH SPHERICAL MULTIPOLE MAGNETIC FIELD

Markek Sadowski 1967 6 p refs

(INR-836/18/PP)

The possibility of application of a spherical high-order multipole as a plasma magnetic trap is considered and various spherical multipoles are described. The approximate formula for particle losses from the icosahedron-geometry trap, as well as comments on the experimental arrangement realized, are given. Author (NSA)

N68-16604# General Electric Co., Philadelphia, Pa. Missile and Space Div.

RADIATION HEAT FLUX FROM HIGH PRESSURE AIR ARCS

C. H. Marston, G. Frind, V. Mishkovsky, and A. M. Schorn Oct. 1967 60 p refs

(Contract AF 40(600)-1126)

(R67SD58; AD-663249)

A method has been developed for computation of radiant interchange within an electric arc where self absorption is important. Most or all radiation in the vacuum u.v. range is reabsorbed before it gets out of the arc. Present values of absorption coefficients are within an order of magnitude of predicting radiation losses as determined by direct experimental measurement. An arc has been operated in air at 100 atmospheres sufficiently quiescent to measure a temperature profile at 100 amperes but great care must be taken to start symmetrically and avoid disturbances. At 400 amperes even extreme precautions are not sufficient to forestall instabilities. The air arc constrictor is uncooled and is designed for quasi-steady operation for 1 to 5 milliseconds depending on current level. Author (TAB)

N68-16656# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.

STABILITY OF A CYLINDRICAL LAYER OF ELECTRONS SURROUNDED BY A METAL SCREEN IN A HOMOGENEOUS MAGNETIC FIELD [USTOICHIVOST' OKRUZHENNOGO METALLICHESKIM EKRANOM TSILINDRICHESKOGO SLOYA ELEKTRONOV V ODNORODNOM MAGNITNOM POLE]

I. N. Ivanov and V. G. Makhan'kov 1967 17 p refs In RUSSIAN

(JINR-P9-3475-2)

The stability of a thin cylindrical electron layer in a magnetic field, in a smooth wave guide (the conductivity of the walls of which are assumed infinite) was investigated. It is shown that not only longitudinal instabilities of the negative mass type are indicated, but transverse channels of instability as well. In contrast to flat geometries, where the increments of channeled instabilites in the presence of screens were increased, in cylindrical layers of screens instabilities of such a type are liquidated. Author (NSA)

N68-16692*# Massachusetts Inst. of Tech., Cambridge. Fluid Mechanics Lab.

A BOUNDARY-LAYER MODEL FOR BALANCED ARCS

Martin D. Cowley Jul. 1967 95 p refs /ts Publ. No. 67-6

(Grant NGR-22-009-052)

(NASA-CR-92886) CFSTI: HC $3.00/MF $0.65 CSCL 20I

The report discusses two-dimensional arcs which are held stationary against the drag of a stream of gas by the force due to an imposed, transverse, magnetic field. In the proposed model, the arc column is a region which is by-passed by the external stream, but which contains an internal circulatory flow. The effective Reynolds number of the circulation is high enough to justify, as a possible and interesting limit, an analysis in which the action of viscosity and heat conduction are assumed to be confined to thin layers. Gas is supposed to drift forward slowly in an inviscid core of the arc and to be returned rapidly in thin shear layers at the edges. An important consequence is that the state of the gas must be constant along a field line in the core, and the model would be invalid if any field lines are closed within the column. A solution is found to the equations governing the shear layers in the vicinity of the forward stagnation point of the arc. The velocity profile is peaked, having a ratio of maximum velocity to local value of the external flow approximately equal to one half the square root of the density ratio across the layer. Author

N68-16700*# National Aeronautics and Space Administration, Washington, D. C.

MAGNETOBREMS (SYNCHROTRON) EMISSION AND REABSORPTION [O MAGNITOTORMOYNOM (SINKHROT-RONNOM)]

V. L. Ginzburg, V. N. Sazonov, and S. I. Syrovatskiy Feb. 1968 41 p refs Transl. into ENGLISH from Preprint No. 83 of Lebedev Phys. Inst. (Moscow), 1967

(NASA-TT-F-521) CFSTI: HC $3.00/MF $0.65 CSCL 20I

The problem of magnetic-acceleration (synchrotron) emission at helical motion of relativistic electrons emitting from a source with relativistic velocity is discussed and mathematically formulated. Problems of reabsorption of magnetobrems emission, with respect to radio emission by quasars, are reviewed, followed by a study of the motion of particles in a magnetic field in the presence of losses. Special emphasis is placed on this motion for particle aggregates of high energy density and the resultant changes in the magnetic field, with formulas for the change in energy of the particle group. Errors in formulas and conclusions by other authors are analyzed. Author

N68-16784*# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

FOCUSSED DISCHARGE FROM PULSED PLASMA GUNS

Dah Yu Cheng 11 Nov. 1967 14 p Presented at Ann. Meeting of Div. of Plasma Phys., Austin, Tex., 8–11 Nov. 1967

(NASA-TM-X-60854) CFSTI: HC $3.00/MF $0.65 CSCL 20I

High-speed blobs of hydrogen plasma are focussed by means of a coaxial gun having a convergent barrel in the shape of a

frustum of a cone. The focal point is at the virtual vertex. The plasma area at the focal point is about 1/100 the breech area, and about 1/4 the muzzle area. About one milligram of cold gas introduced through a fast-acting valve initiates an electric discharge at the breech between the conical barrel and a cylindrical cathode rod on the axis; the barrel initially being evacuated to a pressure of 10^{-7} torr. Plasma and discharge propagate to the muzzle where the plasma is expelled into vacuum. When the barrel is emptied of plasma, the discharge extinguishes. Image-converter camera pictures indicate a muzzle velocity not less than 5×10^{7} cm/sec. Impulse measurements from target discs at the plasma focus suggest an average velocity of about 2×10^{8} cm/sec, and an energy flux of about 200 megawatts/cm^2. Of the 5000 joules initially available in the capacitor-bank driver, about 1200 joules are transferred to the plasma. Author

N68-16823# Columbia Univ., New York. Plasma Lab.
IONIZING SHOCK STRUCTURE IN A MONATOMIC GAS
Donald L. Chubb Mar. 1967 186 p refs
(Contract AF 49(638)-1634)
(Rept.-34; AD-663211)

The structure of an ionizing shock front in a monatomic gas is described. Both atom-atom and electron-atom collisional ionization are considered. The ionization rates for either of these processes is assumed to be controlled by the rate of excitation from the ground state to the first excited level. In the initial part of the shock, called the atom-atom shock, atom collisional dissipative mechanisms (viscosity and thermal conductivity) determine the shock structure. A bimodal Mott-Smith velocity distribution function is assumed for the atoms in this region, which has a thickness of the order of the atom-atom viscosity mean free path. In the final part of the shock front, called the relaxation zone, the collisional ionization processes determine the structure. For this region, which has a thickness proportional to the electron-atom ionization mean free path, Maxwellian velocity distributions are assumed for the electrons, ions, and atoms. It was found that for Mach Numbers of 30 or more the atom-atom shock is of comparable thickness to the relaxation zone. Author (TAB)

N68-16843*# National Aeronautics and Space Administration, Washington, D. C.
THERMODYNAMIC PARAMETERS OF CESIUM BEHIND INCIDENT AND REFLECTED SHOCK WAVES
S. G. Zaytsev *In its* Studies in Phys. Gas Dyn. Feb. 1968 p 31–34 refs (See N68-16839 07-12)

An experimental study of the specific properties of a dense low temperature plasma was conducted in a special shock tube which enabled the study of shock wave propagation in the vapors of alkali metals. Considered is the applicability of cesium for studying the properties of low temperature plasma. Analyzed are the values of the thermodynamic parameters behind an incident and a reflected shock wave for two initial gas states: T_0=700 K; p_0=10 mm Hg. The parameters behind incident and reflected explosions were computed using the equations of conservation of mass, momentum, and energy on a plane shock front. Calculated results were plotted on a graph which indicated the values of temperature and pressure behind incident and reflected shock waves propagated at $M_s\leq12$ and $M_s\leq8$, respectively. It is shown that the cesium plasma obtained behind the incident and reflected shock waves will have an ionization factor of approximately 80%, while the ratio of electrostatic energy to thermal energy, is approximately 20%. Results indicate that (1) in the given case a gas medium can be obtained with properties which differ essentially from the properties of a perfect gas, since the percentage of energy of the electrostatic interaction of particles is comparable with their normal energy; and (2) results of calculating the thermodynamic parameters may be considered only as tentative and indicative of the experimental feasibility of obtaining a low temperature dense plasma. S.C.W.

N68-16846*# National Aeronautics and Space Administration, Washington, D. C.
INVESTIGATION OF THE SPECTRAL CHARACTERISTICS OF GASES HEATED BY SHOCK WAVES
Ye. N. Ambartsumyan, P. V. Ionov, and A. A. Kon'kov *In its* Studies in Phys. Gas Dyn. Feb. 1968 p 63–75 refs (See N68-16839 07-12)

Results of studies of the spectral characteristics of nitrogen, argon, air, and mixtures of carbon dioxide and nitrogen which were made within the following ranges are reported: temperature = 5,000 to 10,000 K; pressure = 5 to 50 atm; and wavelength = 6,000 to 3,000 Å. Experimental apparatus consisted of a shock tube which permitted recording of 2.0 to 10.0 km/sec shock wave velocities. Analyzed were time integral emission spectra of gases heated by strong shock waves, and the distribution of emission and absorption capacities in the visible and ultraviolet regions of the spectrum. The presence of the following were characteristic for the emission spectra of the gases studied: continuous emission; lines of Fe, Cr, Cu, Ca, etc. admixtures; bands of the CN violet system and presumably bands of the N_2 (1+), N_2 (2+), and NO (δ) systems in the spectra of air, nitrogen, CO_2 and N_2 mixtures. The spectra were quantitatively processed by heterochromatic photometry methods. As a result, the distribution of spectral absorption capacity was recorded in reference to the unit length of the absorbent gas layer in dependence on wavelength for nitrogen and nitrogen and carbon dioxide mixtures. The CN violet system made a noticeable contribution to the emission of carbon dioxide and nitrogen mixtures. The accuracy of the results was ±40%. S.C.W.

N68-16848*# National Aeronautics and Space Administration, Washington, D. C.
INVESTIGATION OF THE STRUCTURE OF THE LUMINESCENCE FRONT IN AN ELECTROMAGNETIC SHOCK TUBE
Yu. V. Makarov and A. M. Maksimov *In its* Studies in Phys. Gas Dyn. Feb. 1968 p 86–93 refs (See N68-16839 07-12)

Experimental studies designed to determine the nature and structure of luminescence front propagation in electromagnetic shock tubes using an ultrahigh speed camera; are reported. Results indicate that: (1) At a certain distance from the annular electrode the luminescence front decays with the formation of various instability and is not a shock wave. (2) The luminescence front is a gas discharge plasma which plays the role of a piston in the formation of a shock wave. (3) The region of the shock heated gas between the shock front and the gas discharge plasma is significantly reduced when p_1 (an initial pressure of 0.5 mm Hg) decreases and V_s (velocity of 11.5 km/sec) increases and becomes discernable, i.e., $p_1<0.7$ mm Hg, $V_s>10$ km/sec). (4) Measurements in air, nitrogen, hydrogen, and carbon dioxide indicated that the peculiarity observed in item 2 is characteristic for all investigated gases which indicates that the luminescence front observed in electromagnetic shock tubes by means of optical devices is the boundary of a gas discharge plasma. (5) The decay of the boundary of the gas discharge plasma may lead to a change in the state of the shock heated gas due to the penetration of its tongues into the plug regions. S.C.W.

N68-16849*# National Aeronautics and Space Administration, Washington, D. C.

SPECTROSCOPIC INVESTIGATION OF AN IONIZED GAS IN AN ELECTROMAGNETIC SHOCK TUBE

V. A. Bashilov *In its* Studies in Phys. Gas Dyn. Feb. 1968 p 94–102 refs (See N68-16839 07-12)

Spectroscopic studies of an ionized gas in an electromagnetic shock tube are reported which were designed to analyze the structure of the luminescence front and the existence of a region of a shock heated gas and contact surface having the nature of the substance which moves behind it. Cited are experimental studies involving emission spectrum scanning near the discharge chamber; spectral scanning at a large distance form the discharge chamber; and experiments in which the extent of the region of a shock heated pure gas (plug length) was determined from time scannings of plasma luminescence spectra. S.C.W.

N68-16850*# National Aeronautics and Space Administration, Washington, D. C.

MEASUREMENT OF TEMPERATURE AND DENSITY OF CHARGED PARTICLES OF AN ARGON PLASMA JET

G. P. Petrova *In its* Studies in Phys. Gas Dyn. Feb. 1968 p 103–108 refs (See N68-16839 07-12)

An evaluation of methods used in measuring temperature and density of charged particles in an arc jet of partially ionized argon is presented. Two anode versions of the arc chamber were used, one being made in the form of a conical nozzle, the other in the form of a diaphragm. The density of electrons in the plasma of the argon jet was measured spectroscopically on the basis of the broadening of hydrogen lines. The Ornstein method and the method of hydrogen line broadening were used in determining temperature. Both methods of determining arc jet temperature yielded results which coincided within the limits of experimental errors. It is therefore concluded that important parameters of a plasma jet as temperature and electron density can be determined with sufficient reliability using these methods. A comparison of results of measuring temperature and density for the two anode versions of the arc chamber indicates that the arc jet which flows into the atmosphere from the conical nozzle has a lower temperature and electron density one order lower than the jet which is formed in the short diaphragm anode. S.C.W.

N68-16851*# National Aeronautics and Space Administration Washington, D. C.

JET OUTFLOW OF METALLIC PLASMA INTO A VACUUM

E. K. Chekalin and V. S. Shumanov *In its* Studies in Phys. Gas Dyn. Feb. 1968 p 109–115 refs (See N68-16839 07-12)

Experimental studies of the outflow of metallic plasma into a vacuum which demonstrated that such plasma jets can be used to study heat transfer from a plasma flow to a solid wall, and in aerodynamic studies; are reported. S.C.W.

N68-16852*# National Aeronautics and Space Administration, Washington, D. C.

ELECTRICAL EXPLOSION OF WIRE IN AIR AND IN A VACUUM

E. K. Chekalin and V. S. Shumanov *In its* Studies in Phys. Gas Dyn. Feb. 1968 p 116–125 refs (See N68-16839 07-12)

Presented are results of experiments with an electrical explosion of a copper wire in air and in a vacuum which made it possible to detect essential distinctions between explosion processes in a gaseous medium and in a vacuum. Also included are results of spectroscopic studies of time resolved plasma emission and the volt ampere characteristics of the discharge at the initial stage of the explosion. Experiments designed to study the process of expansion of a plasma cloud in a vacuum and to measure selected plasma parameters are also analyzed. S.C.W.

N68-16854*# National Aeronautics and Space Administration, Washington, D. C.

SECONDARY PHENOMENA DURING THE REFLECTION OF SHOCK WAVES IN ARGON

T. V. Bazhenova and Yu. S. Lobastov *In its* Studies in Phys. Gas Dyn. Feb. 1968 p 138–145 refs (See N68-16839 07-12)

Presented are results of an investigation of ionization processes in argon behind a reflected shock wave. Described are secondary effects, namely, nonstationary propagation of the reflected shock wave, and phenomena occurring during the interaction of the reflected shock wave in argon and the contact surface in the shock tube. S.C.W.

N68-16859*# National Aeronautics and Space Administration, Washington, D. C.

MEASUREMENT OF CARBON DIOXIDE DENSITY IN THE FLOW BEHIND A SHOCK FRONT

S. G. Zaytsev and Ye. V. Lazareva *In its* Studies in Phys. Gas Dyn. Feb. 1968 p 186–188 refs (See N68-16839 07-12)

New density values for the flow parameters of carbon dioxide behind the shock front in a shock tube are reported. Measured were density values of carbon dioxide containing an admixture of less than 0.6% (mainly oxygen and nitrogen). Results obtained were in the M_s range between 2 and 8. Comparison of measured and calculated density values led to the conclusion that directly behind the shock front, the density values (accurate to within 2 to 3%) correspond to the calculated values obtained under the assumption of complete thermodynamic equilibrium. Interferograms of the flow indicate that density is subject to fluctuations relative to the average value of the density behind the shock front which will remain constant within an accuracy of 2 to 3% over the extent of the entire flow from the shock front to the contact surface. The amplitude of the density fluctuations in the flow increased with an increase of the shock front velocity. On the basis of these findings, it is concluded that for temperatures near 2,000°K, the excitation time of the vibrational level for a carbon dioxide molecule does not exceed 2 to 3 μsec. S.C.W.

N68-16860*# National Aeronautics and Space Administration, Washington, D. C.

AN INVESTIGATION OF THE STATE OF A GAS BEHIND A SHOCK WAVE ON THE BASIS OF THE PATTERN OF FLOW AROUND AN OBSTACLE PLACED IN A SHOCK TUBE

I. M. Naboko *In its* Studies in Phys. Gas Dyn. Feb. 1968 p 189–198 refs (See N68-16839 07-12)

Flow parameters behind an incident shock wave were studied on the basis of observing the pattern of flow around an obstacle in a shock tube. The angle of inclination of the Mach line and the angle of inclination of an oblique shock wave were determined. Measurements of the angles of inclination of the Mach line which separates the region of disturbed and undisturbed flows above a plate with an thin edge were suitable for determining the depth of molecular excitation and dissociation of CO_2. Flow parameters behind a shock wave were also calculated for states with a varying degree of vibrational excitation of CO_2 molecules. Angles of inclination of the oblique shock for 10 and 16 flow deflection angles were calculated. Calculations were performed with the equations of the laws of conservation of momentum and energy.

and the discontinuity equation, including the equation of state. Included are tables which list values for the following: (1) a state with excitation of only deformation vibrations taken into account, H_2 and a state with deformation and symmetric valent vibrations taken into account; (2) flow parameters behind shock waves for M_O wave numbers in the 6 to 12 range, or wave velocity in the 1,500 to 3,500 m/sec range; (3) the equilibrium state of excitation of different vibrational modes; and (4) flow deflection angle in an oblique shock wave whose angle of inclination is given. S.C.W.

N68-16931# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.

LATERAL WAVES ON AN EPSTEIN HALF SPACE

R. Lang and J. Shmoys *In its* Microwave Res. Inst. Porgrams Nov. 1967 p 17–21 refs (See N68-16927 07-10)
(Contract AF 19(628)-2357)

Lateral waves excited at diffuse plasma boundaries are studied for the case of a plasma half space with symmetrical Epstein variation. An integral solution for the dielectric profiles of the established reflected field is composed of two ray contributions, reflected and lateral rays. The amplitude of the lateral wave increases as the transition becomes gradual until the lateral rays change into geometric optics. Comparison of the two regions in which the reflected field is evaluated show an overlap when the transition layer thickness is large and the homogeneous half space is small. G.G.

N68-16950# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.

MULTISTREAM APPROACH TO INSTABILITIES IN A MAGNETOPLASMA

F. T. Stone *In its* Microwave Res. Inst. Programs Nov. 1967 p 93–95 refs (See N68-16927 07-10)

Described a multi-stream method to instabilities in a magneto-plasma that considers the system as composed of N streams of charged particles with the K^{th} stream characterized by the velocity vector field. The various possible propagation modes for the system are found by expressing the values of the stream sources in Maxwell's equations. The dispersion equation for the linearized system then determines the stability of instability of the plasma modes. G.G.

N68-16951*# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.

THE TEMPORAL DEVELOPMENT OF THE LUMINOSITY AND ELECTRON TEMPERATURE IN A PULSED HELIUM DISCHARGE

F. Allario and N. Wainfan *In its* Microwave Res. Inst. Programs Nov. 1967 p 95–99 (See N68-16927 07-10)
(Grant NsG-71) CSCL 20I

The temporal development of light spectra emitted by high-current density glows in the time interval between breakdown and current cutoff was used to determine the structural quasi-equilibrium that follows pulsed glow discharges in helium. Spatial distribution of the intensity of several singlet and triplet lines in the helium spectrum was obtained as a function of time, and the Dopper widths of some of the neutral and ionic lines emitted by helium were investigated by Fabry–Perot etalons. Obtained interference fringes represented the time averaged result over the entire discharge pulse, and the Doppler widths of the fringes were used to find the upper limits on the time averaged gas and ion temperatures of the discharge. Results show that as the helium negative glow forms in time out of the positive column, it grows as a region localized in space with an electron temperature distribution which is everywhere larger than the electron temperature of the positive column. G.G.

N68-16952*# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.

TEMPORAL BEHAVIOR OF THE ELECTRIC FIELD AND POTENTIAL DISTRIBUTION IN A PULSED HELIUM DISCHARGE FOLLOWING BREAKDOWN OF THE DISCHARGE GAP

F. Allario and N. Wainfan *In its* Microwave Res. Inst. Programs Nov. 1967 p 100–105 (See N68-16927 07-10)
(Grant NsG-71) CSCL 20I

The temporal behavior of the spatial distribution of the electric field strength and the potential distribution in a microsecond pulsed glow discharge in helium and hydrogen and helium hydrogen mixtures has been obtained experimentally. In these microsecond glow discharges, the quasi-steady state current densities ranged between 2 and 10 amperes per cm^2 for pressures of the order of several torr. These current denisities reported in the literature for the operation of stable d-c glow discharges, generated in the same pressure region. Three different techniques were employed to obtain the temporal development of the electric field strength and potential distribution in the discharge. Two were spectroscopic and the third was electrostatic. Author

N68-16953# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.

A DYNAMIC IONIZATION PHENOMENON IN LOW PRESSURE BREAKDOWN

J. W. E. Griemsmann and D. Jacenko *In its* Microwave Res. Inst. Programs Nov. 1967 p 105–108 (See N68-16927 07-10)
(Contract Nonr-839(38))

A sealed C band wave guide, fitted with a microwave window and filled with pressurized gas, is exposed to microwave power impingement on its plasma. This creates an ionized region at the end of the length of the waveguide that propagates toward the microwave source at a velocity depending on power level and pressure. Oscilloscope tracings for various power levels are shown graphically and give the incident power curve, the power transmitted beyond the ionized region, the reflected power, the voltage picked up by an r.f. probe situated at the input of the guide, and the voltage picked up by d.c. conductivity probes. It was found that the reflected wave changes phase continuously as the ionized region travels toward the source. G.G.

N68-16954# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.

PULSED LASER GENERATION OF HIGH TEMPERATURE PLASMAS

G. Gould and L. Silverstein *In its* Microwave Res. Inst. Programs Nov. 1967 p 109–112 refs (See N68-16927 07-10)
(Grant NSF GU-1557)

Analyzed is the multiple stripping problem of a dense, cold singly-ionized plasma model that is subjected to a rectangular pulse of laser radiation. Temperature, density, and dimensional calculations of the model, as it evolves through the various stages of heating by inverse bremsstrahlung absorption of the laser radiation, are evaluated and the fractional densities of multiple ionized atoms at each stage of plasma development are determined. An equation is formed that expresses coronal plasma equilibrium

at the maximum electron temperatures which are needed to obtain substantial numbers of single-electron heavy ions. This makes it possible to predict Lamb shift measurements in heavy elements and the temperature required to achieve substantial populations in any specified ionization stage. G.G.

N68-17019# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
LIQUID METAL IN THE ELECTROMAGNETIC FIELD
I. M. Kirko 27 Apr. 1967 126 p refs Transl. into ENGLISH of the book "Zhidkiy Metall v Elektromagnitnom Pole" Moscow, Izd. Energiya., 1964 p 1–160
(FTD-MT-65-535; AD-663352)

Consideration is given to the magnetohydrodynamic phenomena in liquid metals and electrolytes found in an electromagnetic field. All expanded uses of these phenomena are expounded in electromagnetic pumps, mixers, melting without crucible, and other important processes for practice. Author (TAB)

N68-17070*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CORRELATION OF TRANSIENT SPECTRA WITH PERFORMANCE IN COAXIAL PLASMA GUNS
Charles J. Michels and Henry J. Hettel Washington Feb. 1968 32 p refs
(NASA-TN-D-4385) CFSTI: HC $3.00/MF $0.65 CSCL 20I

The time-varying spectra of an argon plasma in a coaxial gun were measured. Two gun geometries were investigated, both with argon propellant. The transient spectra were obtained by viewing the plasma spectra in the exit plane of a polychromator with an electronic image converter camera used as a streak camera. Frame and streak camera views and magnetic probes were also used to study the discharges occurring in the guns. The transient spectrum of each gun was completely different. The geometry which exhibits relatively clean argon spectra showed good performance. It operated internally crowbarred. The performance correlates well with both earlier theory and experiments and extends previous data. In contrast, the geometry which exhibited contaminant spectra showed poorer performance which does not agree with theory or past experimental data. This geometry operated in the multiple-moving-discharges mode. The discharge spectra showed no argon lines, and the contaminant lines were those from a pyrex gas baffle just upstream of the gas ports. The influence of the gas baffle on performance accounts for discrepancies with earlier data (both experimental and theoretical). The two different geometries of the guns served to demonstrate the usefulness of transient spectra diagnostics as an added tool in ascertaining when theory can correctly be applied to a given gun. A description of a two-channel transient voltage digitizer is given. The digitizer is used to record dynamically gun voltage and current at the rate of 5 million samples per second. It digitizes these samples and punches them on paper tape for data reduction by a conventional high-speed computer Author

N68-17071# Toronto Univ. (Ontario). Institute for Aerospace Studies.
MAGNETOHYDRODYNAMIC FLOW NEAR A STAGNATION POINT
Elie J. Stubbe Jan. 1968 71 p refs Sponsored in part by the Defense Res. Board of Canada
(Grant AF-AFOSR-366-66)
(UTIAS-TN-122; AFOSR-68-0063)

Some interaction effects of a plasma flowing around a blunt body in the presence of a strong magnetic field have been investigated. A one inch circular shock tube was used to provide the plasma during a testing time of approximately 30 μsec. The required magnetic field strength was produced by discharging a 0.238 F electrolytic capacitor bank through a coil. Interaction effects of the plasma with the applied magnetic field have been observed in the form of an appreciable change in stand-off distance of the bow wave. The behavior of the induced currents and the induced flux density were examined by using three pick-up coils placed around shock tube. This arrangement also made it possible to gain some more information about the available testing time and the values of the effective electrical conductivity of the argon plasma. Calculations covering a shock Mach number range from 9 to 19 are presented and a simple theory is worked out for the particular magnetic field configuration. The validity and the significance of the calculations and experiments are discussed together with some proposals for further work. Author

N68-17097# Nagoya Univ. (Japan). Inst. of Plasma Physics.
A NEGATIVE V" SYSTEM AND ITS EQUILIBRIUM
Tsueno Amano (Kyoto Univ.) Nov. 1967 27 p refs
(IPPJ-61)

A negative V' configuration is obtained by applying $l=2$ and $l=3$ helical multipolor fields on a toroidal magnetic field. An analytical and numerical analysis indicates that the negative V' condition can be achieved in a wide region in this way. The plasma pressure effect on the configuration is also considered. Author

N68-17104# Joint Inst. for Nuclear Research, Dubna (USSR).
ELECTRIC FIELD IN THE CENTRAL REGION OF THE SYNCHROCYCLOTRON [ELEKTRICHESKOE POLE V TSENTRAL'NOI OBLASTI SINKHROTSIKLOTRONA]
V. I. Danilov and I. V. Puzynin 1967 41 p refs
(JINR-P9-3497)

Main features of the distribution of the electric field, which is induced between accelerating electrodes in the central region of the synchrocyclotron, are investigated. It is necessary to know the components of the electric field in order to formulate and solve the problems of the phase motion and the effect of space charge on the initial process of acceleration taking into account the dependence of the electric field amplitude not only on time but also on the space coordinates. Author (NSA)

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N68-16112*# Massachusetts Inst. of Tech., Cambridge.
SPECTRUM AND POLARIZATION OF LASER LIGHT SCATTERED BY SOLIDS
G. B. Benedek, J. D. Litster, and J. T. Ho [1967] 3 p
(Grant NGR-22-009-182)
(NASA-CR-92719) CFSTI: HC $3.00/MF $0.65 CSCL 20L

Experimental efforts on scattering of laser light from yttrium iron garnet are reported. The Faraday rotation in $CrBr_3$ is mentioned, along with the difficulties encountered in the light scattering experiments. B.S.D.

N68-16185# National Research Council of Canada, Ottawa (Ontario).
THE INTRINSIC FLUORESCENCE OF THE NAPHTHALENE CRYSTAL AT 4.2°K [DIE EIGENFLUORESZENZ DES NAPHTHAL INKRISTALLS BEI 4.2°K]
H. C. Wolf 1967 3 p refs Transl. into ENGLISH from Naturwissenschaften (Berlin), v. 48, no. 2, 1961 p 43–44
(NRC-TT-1269)

The fluorescence spectrum of pure naphthalene crystals changes fundamentally between 14 and 4.2 deg K. At 4.2 deg K the radiationless energy transfer is frozen. Author

N68-16258# Massachusetts Inst. of Tech., Cambridge. Dept. of Electrical Engineering.
SELF-CONSISTENT CLUSTER TREATMENT OF KINETIC AND MAGNETIC EFFECTS IN NARROW ENERGY BANDS
Laurent Gerard Caron (Ph.D. Thesis) 29 Sep. 1967 160 p refs
(Contract Nonr-1841(51))
(TR-6; AD-663290)

A new self-consistent cluster method is developed to account for electronic motion in narrow energy bands. This technique is first applied to Hubbards Hamiltonian. Results are given. TAB

N68-16278# Air Force Systems Command, Wright-Patterson AFB, Ohio. Translation Div.
CERTAIN ELECTRICAL PROPERTIES OF THIN FILMS OF THE GATE SYSTEM [NEKOTORYYE ELEKTRICHESKIYE SVOYSTVA TONKIKH SLOYEV SISTEMY GATE]
V. I. Gramatskiy and V. P. Mushinskiy 3 Aug. 1967 10 p refs Transl. into ENGLISH from Kishinev. Univ. Uch. Zap. (USSR), v. 69, 1964 p 38–40
(FTD-HT-23-634-67; AD-663348)

A study was made of the electrical conductivity and thermoelectric power of thin, vapor-deposited films of GaTe and Ga2Te3. Thin films of the Ga-Te system were obtained by the evaporation of massive polycrystalline and monocrystalline specimens of GaTe and Ga2Te3 in a vacuum of the order of 0.00001 mm. Hg, and also by the Vekshinsky method. The substrates were glass and mica, at controlled temperatures. The physical properties of the films were found to depend upon many factors, such as the velocity of sublimation, temperature of the substrate, etc. However, the substrate material did not significantly affect the film electrical properties. To exclude anomalies related to excessively thin films, films at least .2 micron thick were used. Measurements of electrical conductivity and differential thermoelectric power were made under vacuum. Curves of temperature dependence of the electrical conductivity of thin films of GaTe and Ga2Te3 are given for a temperature range of -183C to +300C, obtained both in vacuum and in air. The forbidden zone width of Ga2Te3, determined from the slope of the logarithm of the conductivity curve plotted vs. the inverse temperature, was 1.56 electron volts, in agreement with known optically determined data. The differential thermoelectric power (relative to copper) of thin films showed little temperature dependence; it was of the order of 450 microvolts/degree C. for GaTe, and 500 microvolts/degree C. for Ga2Te3. TAB

N68-16383# Stanford Univ., Calif. Dept. of Materials Science.
THE GENERATION OF SCIENCE-BASED TECHNOLOGY IN THE FIELD OF CRYSTALLIZATION
William A. Tiller *In* Office of Aerospace Res. Proc. of the OAR Res. Appl. Conf., 14 Mar. 1967 Mar. 1967 p 107–155 refs (See N68-16376 07-34)

Basic research on "Crystallogenics" has produced a sufficiently strong base of scientific understanding that the field of crystallization is rapidly becoming an engineering science. Attendent technological applications have begun to appear in three areas: (1) single crystal growth, (2) materials purification, and (3) structure control of ingots and casting. By studying the crystallization of selenium at high pressures, a technique and control criteria were generated for preparing large single crystals. The experimental procedure should be useful for the controlled crystallization of a host of other materials consisting of associated molecules. From interface stability studies, it has been possible to quantitatively describe the freezing conditions that must be maintained for effective purification of a material by the freezing process. Simple devices can be designed for effective saline water purification or for producing ultra-pure water. The investigation of crystal multiplication phenomena during crystallization under the influence of moving electromagnetic fields has led to the generation of extremely fine grained and chemically homogeneous cast metals. Author

N68-16386# Air Force Cambridge Research Labs., Bedford, Mass. Space Physics Lab.
ORGANIC PHOTOVOLTAIC DEVICES
Aleksandar Golubovic *In* Office of Aerospace Res. Proc. of the OAR Res. Appl. Conf., 14 Mar. 1967 Mar. 1967 p 211–225 refs (See N68-16376 07-34)

Different materials and cell parameters have been examined in an attempt to increase the power output of cells made from organic thin films by decreasing the internal resistance. Photovoltaic cells containing organic materials have been prepared. The fabrication of such cells involved a sublimed layer of an organic photoconductor sandwiched between aluminum and gold electrodes. The photocurrent output of the above cells has been enhanced by secondary layers of electron acceptors. Author

N68-16404# Delaware Univ., Newark. Dept. of Physics.
RADIATION-INDUCED DEFECTS IN ALKALI HALIDES, AND THEIR ROLE IN RECOMBINATION PROCESSES Progress Report, 1 Mar. 1967–29 Feb. 1968
R. B. Murray 20 Nov. 1967 7 p
(Contract AT(30-1)-3842)
(NYO-3842-1) CFSTI: HC $3.00/MF $0.65

Equipment has been procured and installed in the laboratory. Experiments on the Pooley–Hersh mechanism in KBr(Tl) are planned. Experiments on the V_z center in KCl were performed to determine whether reorientation in an electronic excited state exhibits a correlation between initial and final position similar to that observed in thermally excited reorientation. The results are summarized. Experiments were initiated to look for $(e^- + V_z)$ luminescence in LiF. Work is in progress on identification of V_z absorption and $(e^- + V_z)$ luminescence in NaCl. NSA

N68-16415# Naval Undersea Warfare Center, San Diego, Calif.
INSTRUMENTS FOR USE IN SOLID STATE SCIENCE RESEARCH Research and Development Report, Jun. 1962–Dec. 1966
G. W. Marks 18 Aug. 1967 30 p refs
(NUWC-TP-13; AD-663121)

The report describes the following instruments designed and constructed at NEL for use in solid state science research: (1) specimen holder for electrical studies at high temperature, (2) specimen holder for electrical studies at low temperatures, (3) specimen holder for sound velocity measurements at high temperatures, (4) specimen holder for sound velocity measurements at low temperatures, (5) cylinder for grinding small spheres, (6) electron bombardment chamber, (7) high pressure system, and (8) calorimeter for high temperatures. TAB

N68-16489# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SEMICONDUCTORS AND THEIR APPLICATION IN TECHNOLOGY

I. Voloshin, M. Doroshevich, N. Karachentseva, A. Kasperovich, V. Kupchinov, et al. 9 Jun. 1967 251 p refs Transl. into ENGLISH of the book "Poluprovodniki i Ikh Primeneniye v Tekhnike" Minsk, Izd. Belarus, 1963 p 1–287

(FTD-HT-65-146; AD-663336)

The book describes the basic physical properties of semiconductors and how they are affected by various factors. The design, parameters, and characteristics of thermistor, Hall gages, photodiodes, phototriodes, photoresistances, and ferrites are given. There is also an examination of the operating regimes of electrical circuits and circuits using semiconductors are shown. The book is intended for a broad circle of engineers and technicians working in the automation of production processes. Author (TAB)

N68-16497# Cornell Univ., Ithaca, N. Y. Materials Science Center.

NATURE OF AC TRANSDUCERS AND CRITICAL CURRENTS IN THE SUPERCONDUCTING SURFACE SHEATH

Roger William Rollins (Ph.D. Thesis) Feb. 1967 150 p refs Sponsored by AEC-ARPA

(NYO-3029-13; Rept.-596) CFSTI: HC $3.00/MF $0.65

The response of cylindrical type-II superconductors in the superconducting surface sheath state to an axial, low-frequence, small-amplitude ac field superimposed on an axial dc field has been studied. Screening currents are developed in the sheath up to a critical value J_c when the field begins to penetrate. The screening current continues to increase until a saturation value J_s is reached at which point the current in the sheath stays constant for the remainder of the half cycle. For low exciting frequencies, J_s approaches J_c for perfect surface conditions. Fourier analysis of a model waveform is interpreted simply in terms of free-energy diagrams for the superconducting sheath state based on a Ginzburg–Landau equivalent of the London fluxoid conservation concept. Measurements of the in- and out-of-phase components of the internal field at the fundamental frequency as a function of the ac field amplitude at constant dc field show that the transition is characterized by only one parameter dependent on the dc field and that the proposed model gives an excellent description of the nonlinearity. The relationship between these observations and other measurements of the complex ac permeability as a function of the dc field at constant ac field amplitude is discussed. The model is used to obtain well defined critical-current data for comparison with theories. The values obtained are, in general, much lower near H_{c3} than any of the theories predict. Transition is very sensitive to misalignment of the specimen relative to the dc field. No size dependence of the critical current is observed. The frequency dependence of the transitions in the surface sheath are interpreted in terms of finite lifetimes for the metastable current carrying states of the surface sheath. Energy is dissipated by the surface sheath during the course of transitions between metastable superconducting sheath states enclosing different numbers of fluxoids. Author (NSA)

N68-16510*# Southern Methodist Univ., Dallas, Tex.

A STUDY OF THE ABSORPTION COEFFICIENT OF SILICON IN THE WAVE LENGTH REGION BETWEEN .5 AND 1.1 MICRONS Final Report

W. R. Runyan [1967] 17 p refs

(Grant NGR-44-007-016)

(NASA-CR-93154; SMU-83-13) CFSTI: HC $3.00/MF $0.65 CSCL 20L

The goal of this study was to examine the absorption coefficient of silicon in the wavelength region from 0.5 to 1 micron as a function of doping level and crystal damage in order that solar cell performance might be predicted. Author

N68-16531# Purdue Univ., Lafayette, Ind.

MATERIALS SCIENCES RESEARCH Progress Report, 1 Oct. 1966–30 Sep. 1967

1 Nov. 1967 179 p refs

(Contract ARPA SD-102)

Summary data on the various areas and phases of research projects in material sciences are presented. Materials analysis studies are being made employing gas-chromatography and a modification of the neutron activation technique for rapid and sensitive chemical characterization of natural and artificial materials. Band structure and excitations in AgBr are examined by measuring optical properties, and methods of studying lattice defects and chemical impurities in semiconductors are reported. The kinetics of surface-controlled reactions, and the role of morphology of the substrate on metallic deposition are investigated. Methods for obtaining mechanical property data are assessed. Molecular beam techniques for studying intermolecular potentials are discussed, and infrared and Raman spectral analyses on transition metal carbonyls and on ionic gasses are considered. Investigations on the transport properties and thermophysical properties are included. A publications bibliography is included. B.S.D.

N68-16648# Los Alamos Scientific Lab., N. Mex.

LATTICE DYNAMICS OF BISMUTH

Darryl B. Smith (Ph.D. Thesis, N. Mex. Univ.) 13 Nov. 1967 101 p refs

(Contract W-7405-ENG-36)

(LA-3773; UC-34) CFSTI: HC $3.00/MF $0.65

Dispersion curves for phonons propagating in the binary and ΓX directions in bismuth at 75°K have been measured by inelastic neutron scattering. A group theoretical analysis of modes of vibration in the bismuth lattice has been made. The results were used to label the branches of the dispersion relation, and to reduce the dynamical matrices for phonon propagation in the trigonal, binary, and ΓX directions to block diagonal form. Both a second-neighbor general Born–von Karman force model and this model augmented by the inclusion of axially symmetric third- and fourth-neighbor force constants were constructed and were fitted to the present day and to previous data for the trigonal direction. Although the second of these models reproduced the general features of the data, it was concluded that forces due to atoms beyond fourth-nearest neighbors are required to fit the data within the experimental errors. The phonon frequencies at the symmetry points X and L in the Brillouin zone were used along with a recent measurement of the electron–hole recombination time in bismuth to determine the location of the valence band maxima. The data favor these maxima being at the points T in the Brillouin zone. Author (NSA)

N68-16722# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.

ON THE INTERACTION OF INCLUSIONS WITH MIGRATING GRAIN BOUNDARIES

M. F. Ashby and J. Lewis Nov. 1967 38 p refs

(Contract Nonr-1866(27))

(TR-547; AD-663172)

The pinning force exerted by an inclusion or particle of a second phase on a migrating grain boundary is calculated, allowing for the nature of the inclusion-matrix interface. The shape of a grain boundary as it bulges between inclusions can be described by a differential equation which is solved numerically to

obtain profiles of boundaries as they interact with inclusions. These profiles suggest that the pressure on a grain boundary, causing it to migrate, can be obtained experimentally by measuring the amount by which a boundary bulges between inclusions. This makes possible an experimental measurement of the pinning force exerted by a single inclusion. Author (TAB)

N68-16760*# Field Emission Corp., McMinnville, Oreg.
INVESTIGATIONS OF ELECTRON EMISSION CHARACTERISTICS OF LOW WORK FUNCTION SURFACES Final Report, 28 Sep. 1966–13 Nov. 1967
L. W. Swanson, A. E. Bell, L. C. Crouser, B. E. Evans, and R. W. Strayer Nov. 1967 113 p refs
(Contract NASw-1516)
(NASA-CR-92725) CFSTI: HC $3.00/MF $0.65 CSCL 20L

CONTENTS:

1. ADSORPTION OF CESIUM FLUORIDE ON TUNGSTEN p 4–30 refs (See N68-16761 07-26)

2. SINGLE PLANE WORK FUNCTION COVERAGE RELATIONSHIPS FOR CESIUM AND OXYGEN COADSORBED ON TUNGSTEN p 31–53 refs (See N68-16762 07-26)

3. STUDIES OF THE ADSORPTION AND DESORPTION OF MERCURY ON CLEAN AND OXYGENATED TUNGSTEN p 54–58 refs (See N68-16763 07-26)

4. STABILITY STUDIES OF FIELD EMISSION CATHODES p 59–71 (See N68-16764 07-26)

5. TOTAL ENERGY DISTRIBUTION STUDIES OF FIELD EMITTED ELECTRONS FROM CLEAN MOLYBDENUM p 72–91 refs (See N68-16765 07-26)

6. THE EFFECT OF ADSORBED CESIUM ON THE TOTAL ENERGY DISTRIBUTION OF FIELD EMITTED ELECTRONS p 92–105 refs (See N68-16766 07-26)

N68-16761*# Field Emission Corp., McMinnville, Oreg.
ADSORPTION OF CESIUM FLUORIDE ON TUNGSTEN
In its Invest. of Electron Emission Characteristics of Low Work Function Surfaces Nov. 1967 p 4–30 refs (See N68-16760 07-26)

In view of the enhanced work function lowering of coadsorbed systems involving highly electropositive and electronegative adsorbates, interest was centered on examining the most extreme example of these adsorbates, namely the Cs–F–W system. The most pertinent properties of oxygen and fluoride are tabulated. Data are presented on the measurement of work function Cs coverage relationships for various underlying coverages of F_2 on W. To verify the use of the field emission microscope, equations are derived to confirm the law of field emission in terms of directly measurable field emission current and applied electric field. The general behavior of CsF on W is examined in relation to migration, fluorine adsorption–desorption on tungsten, and adsorption and desorption of cesium on a F–W layer. Surface kinetic studies of diffusion and desorption, and the temperature dependency of work function for the Cs–F–W system are also discussed. M.G.J.

N68-16762*# Field Emission Corp., McMinnville, Oreg.
SINGLE PLANE WORK FUNCTION COVERAGE RELATIONSHIPS FOR CESIUM AND OXYGEN COADSORBED ON TUNGSTEN
In its Invest. of Electron Emission Characteristics of Low Work Function Surfaces Nov. 1967 p 31–53 refs (See N68-16760 07-26)

Due to data obtained on the remarkable effects of preadsorbed oxygen on cesium layer properties, a probe field emission study was undertaken on the Cs/O/W system. Suitable for both work function and energy distribution measurements on any plane, the tube contains both a cesium and an oxygen source so that measurements may be carried out on single or coadsorbed layers of the adsorbates. Experimental procedures are detailed. Changes are depicted in work function and pre-exponential term B for the [110], [211], [100], and [111] planes of partially oxygen-coated tungsten as functions of cesium coverage. It is pointed out that the striking change in the emission distribution of the cesium-coated surface with the addition of small amounts of oxygen can be explained in part by substrate–adsorbate geometric factors. Summary data are presented on a hard sphere model of maximum cesium atom density, ratio of oxygen atom density to cesium atom density, and Cs–O bond distances for saturated layers of cesium and oxygen on the various planes of tungsten. M.G.J.

N68-16763*# Field Emission Corp., McMinnville, Oreg.
STUDIES OF THE ADSORPTION AND DESORPTION OF MERCURY ON CLEAN AND OXYGENATED TUNGSTEN
In its Invest. of Electron Emission Characteristics of Low Work Function Surfaces Nov. 1967 p 54–58 refs (See N68-16760 07-26)

Studies were undertaken on the mercury–tungsten system to extend the experimental base for formulating empirical and theoretical models of a metallic adsorption. Experimental procedures for determining field desorption are briefly stated, along with the procedures for studying coadsorption of mercury and oxygen on tungsten. Summary data are presented on the investigation of Hg adsorption on a W surface containing a small amount of preadsorbed oxygen which was equilibrated at 500°K prior to Hg deposition. Comparing these results with Hg adsorption on clean W, it was noted that the primary influence of O is to reduce the maximum work function from 4.9 eV for clean W to 4.68 eV. The terminal desorption temperature of Hg from clean W is approximately 590°K, whereas from the oxygenated surface Hg is removed at a slightly lower temperature, i.e., ≈530°K. On the other hand, the equilibrium temperature, which is a measure of the surface mobility of Hg, is found to be essentially unchanged by the presence of this amount of O. M.G.J.

N68-16764*# Field Emission Corp., McMinnville, Oreg.
STABILITY STUDIES OF FIELD EMISSION CATHODES
In its Invest. of Electron Emission Characteristics of Low Work Function Surfaces Nov. 1967 p 59–71 (See N68-16760 07-26)

The origin of ionic bombardment is examined, and attempts are made to suppress ionic bombardment of the emitter by creating potential saddles for ions in front of the emitter surface, and by reducing the collected electron energy below the threshold for electron-induced desorption. Descriptive details and schematic diagrams are given for the two experimental tubes used. The differences in the operating conditions of the ion suppression mode and the simple diode mode are delineated, and it is pointed out that when operated in the ion suppression mode nearly all electrons are collected in a Faraday cup on clean metal surfaces, whereas operation in the diode mode does not limit electron collection to any one surface. Based on the results, it is assumed: (1) Two effects involved in the current instability of Zr/O/W coated field emitters are neutral and ion bombardment of the tip during operation. (2) More stable operation of this type of cathode coating results from collecting electrons on low voltage, clean surfaces which reduces the probability of electron desorption of adsorbed gases. M.G.J.

N68-16765*# Field Emission Corp., McMinnville, Oreg.
TOTAL ENERGY DISTRIBUTION STUDIES OF FIELD EMITTED ELECTRONS FROM CLEAN MOLYBDENUM

In its Invest. of Electron Emission Characteristics of Low Work Function Surfaces Nov. 1967 p 72–91 refs (See N68-16760 07-26)

The total energy distribution (TED) along the [100] of Mo is investigated, and equations are derived based on the theory of field emission. The data are plotted, and the most striking feature of the TED results is considered to be the band structure effects noted along the [100]. This apparently correlates with the theoretical band structure, if the two peaks are attributed to electron emission from the upper and lower Δ_7 bands. Good agreement was also found between ϕ_f and thermionic values of the Mo work function. M.G.J.

N68-16768*# Field Emission Corp., McMinnville, Oreg.
THE EFFECT OF ADSORBED CESIUM ON THE TOTAL ENERGY DISTRIBUTION OF FIELD EMITTED ELECTRONS
In its Invest. of Electron Emission Characteristics of Low Work Function Surfaces Nov. 1967 p 92–105 refs (See N68-16760 07-26)

Preliminary results are presented on experiments conducted to determine the influence of adsorbed cesium layers on the total energy distribution (TED) and emission characteristics of field emitted electrons. The TED and current voltage I(V) data from various planes of molybdenum and tungsten coated with cesium were analyzed. Figures depict the TED along the [110] direction of Mo at 77°K as a function of Cs coverage and applied field strengths. In attempts to ascertain the appropriate theoretical description of the effect of adsorbed layers, consideration was given to a theoretical basis for treating field emission through adsorbed atoms by an atomistic one-dimensional pseudo-potential model (D–A theory). The results indicate that, except for the lower coverage Mo [110] results enhancement of the emission as predicted by the D–A theory for metallic adsorption is not observed. In addition, all other directions show a decrease in the log A_f term, and no obvious alterations of the TED curves are observed throughout the coverage range of Cs. It was felt that a polarization model gives sensible results except at low coverages and on the [100] plane of Mo. M.G.J.

N68-16797# University of Southern Calif., Los Angeles. Dept. of Electrical Engineering.
ELECTRON PROBE ANALYSIS OF SEMICONDUCTORS Final Report
David B. Wittry and David F. Kyser Sep. 1967 16 p refs
(Grant AF-AFOSR-76-66)
(USCEE-233; AFOSR-67-2830; AD-663242)

The report summarizes the research in electron probe analysis of semiconductors. Contributions were made in the following areas: (1) Cathodoluminescence Microscopy, (2) Diffusion and Recombination of Excess Carriers in GaAs, (3) Electron Microprobe Instrumentation, and (4) Quantitative Electron Probe Microanalysis. Author (TAB)

N68-16822*# Marquardt Corp., Van Nuys, Calif.
DEVELOPMENT OF A MULTIELEMENT DETECTOR STRIP Final Report, 31 May–31 Dec. 1966
Peter M. Grant and Jacques M. Hanlet 31 Dec. 1966 45 p
(Contract NAS5-10193)
(NASA-CR-92671) CFSTI: HC $3.00/MF $0.65 CSCL 20L

The development of suitable thin film solid state material deposition and fabrication techniques was undertaken and directed toward the design of an advanced star detector strip with electronic readout for star pattern recognition applications from a spinning spacecraft. Several advances in the performance characteristics of thin film materials are reported. A photoconductor with a dark to light ratio of 10^9, a dark resistance of 10^{12} ohms and a sensitivity of better than 20 amperes per lumen was developed over a comparatively large area (4×4 inches). A highly transparent (90% transmission) conductor exhibiting a resistance of from 5 to 8 ohms per square was produced. The design and fabrication of a 50 element detector strip and the preparation of the spinning star simulator of the breadboard detector strip are described. The evaluation of the strip shows that the detector cells can provide star pattern sensing under simulated conditions. Test results indicate a high degree of electrical and optical isolation between cells of the detector strip based on signal to noise ratio and crosstalk measurements. In addition, a suggested 50 element sequential commutator design is presented based on a thin film solid state switching element which could be suitable for constructing a thin film commutator as an integral part of the detector strip. Author

N68-16956# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.
FERROMAGNETIC MANGANITES WITH THE PEROVSKITE STRUCTURE
E. Banks and N. Tashima *In its* Microwave Res. Inst. Programs Nov. 1967 p 116–117 (See N68-16927 07-10)

Diffraction patterns from ferromagnetic compositions of the series $La_{1-x}Pb_xMnO_{3-x}F_x$ prepared in sealed platinum tubes under a dried N_2 atmosphere, and from ferromagnetic lanthanum-lead manganites of the general formula $La_{1-x}Pb_xMnO_3$ prepared in an oxygen atmosphere, were compared and analyzed. It was found that the cell constants differed for samples of the same lead content, as well as the Curie temperatures and the magnetic moments. Ferromagnetic compounds with about equal amonts of Mn^{3+} and Mn^{4+} had a low temperature moment of 3.5 u_B/Mn atom except for samples prepared with fluorine which had values close to that expected for Mn^{3+}. Single crystals showed a fairly low resistance, suggesting semiconducting behavior. G.G.

N68-16957# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.
EFFECT OF HIGH PRESSURE ON THE CURIE TEMPERATURES OF FERROMAGNETIC MATERIALS
G. T. Alfieri, K. Kanematsu, B. Post, and E. Banks *In its* Microwave Res. Inst. Programs Nov. 1967 p 118–120 refs (See N68-16927 07-10)
(Contracts DA-31-124-ARO(D)-70; F33615-67-C-1240)

The exchange interaction in cubic $ZrFe_2$–$NbFe_2$ and $ZrFe_2$–$ZrCo_2$ and in the rare earth zinc intermetallic compound GdZn were studied when the magnetic samples were under high pressure. Results showed that in the $(Zr,Nb)Fe_2$ and the $Zr(Fe,Co)_2$ series, the interatomic distances and Curie temperatures decreased when the increasing Nb or Co content caused a narrowing of the Fe–Fe distance. This effect ran parallel to increasing pressure. Reported slopes for the Curie point–pressure relation indicated that the change in Curie point with interatomic distance was essentially constant. In the case of the rare earth zinc compounds, the much smaller variation of the Curie point in GdZn with pressure suggests that the rare earth compounds in this region lie closer to the maximum of the Heisenberg curve. G.G.

N68-16958*# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.
SPIN WAVE BOUNDARY CONDITIONS IN FERROMAGNETIC THIN FILMS
W. Moller and H. J. Juretschke *In its* Microwave Res. Inst. Programs Nov. 1967 p 120–123 refs (See N68-16927 07-10)
(Grant NsG-589) CSCL 20L

The effects of boundary conditions on spin-wave mode shapes at surfaces of thin magnetic films were studied for the case in which the magnetization lies in the film plane. Microwave galvanomagnetic measurements and resonance-absorption curves for a film of 82% Ni–18% Fe melt composition and of 1200 Å thickness showed that, as the surfaces became more pinned, the main resonance shifted away from the unpinned value in a direction determined initially by the sign of the normal magnetization derivative at the surfaces. Since the dc signals remained almost the same when the film was reversed in orientation it was concluded that the sign of the net galvanometric effects was determined by excitation conditions rather than surface properties. Deposition of a Ni layer onto the completed film shifted its main resonance upward in field. G.G.

N68-16959# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.

WAVELENGTH DEPENDENCE OF THE FARADAY ROTATION IN NICKEL

L. Indyk and H. J. Juretschke *In its* Microwave Res. Inst. Programs Nov. 1967 p 123–128 refs (See N68-16927 07-10)
(Grant NSF GP-5592)

The wavelength dependence of the Faraday rotation in nickel films was measured in the visible and near infrared region of the spectrum and interpreted in terms of band structure. Faraday rotation measurements by photoelectric polarimeter on three thin polycrystalline nickel films deposited on very thin pyrex slides were obtained as functions of incident light energy. Observed resonances in the wavelength dependence of the Faraday effect were attributed to transitions between the spin-polarized 3d-bands and the 4s conduction band. On the short wavelength side of the transition, the effective dielectric constant was proportional to $(1/w^2)$ where w represents the angular frequency of the light. Thus, it was concluded that the Faraday rotation in the visible is connected with an interband energy transition of about 1.30 ev. The calculated effective dielectric constant for the long wavelength side of the transition was 1.5 microns. An overall curve of the dispersion of the effective dielectric constant was interpreted so that the transition at 4.5 microns was attributed to an interband transition at the L point of the Brillouin zone; the point of origin of the 1 micron (130 ev) transition was not located. G.G.

N68-16960# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.

INTERPRETATION OF THE OPTICAL SPECTRUM OF Yb^{3+} IN CdF_2 WITH THE AID OF ESR SPECTROSCOPY

E. Banks, V. J. Abbruscato, and B. R. McGarvey *In its* Microwave Res. Inst. Programs Nov. 1967 p 128–129 (See N68-16927 07-10)
(Contract DA-31-124-ARO(D)-71)

The optical and ESR spectra of crystals of CdF_2 doped with Yb^{3+} alone, and with co-dopants such as Na^+, Y^{3+}, and Eu^{3+} were studied and the oscillator strengths of the observed spectral lines were calculated. The ESR spectrum of Yb^{3+} exhibited cubic symmetry that changed to a non-cubic ESR spectrum when increasing amounts of Na^+ were added. Analysis of this non-cubic spectrum showed an orthorhombic symmetry with the major distortion axis in the (110) direction. The non-cubic spectrum found in the presence of excess Y^{3+} concentration was not analyzed. The optical spectrum in the presence of Na^+ exhibited line splitting and absorptions by Yb^{3+} in cubic and non-cubic sites at 10,395 cm^{-1} and 10,870 cm^{-1}. G.G.

N68-16962# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.

ELECTROCHEMICAL BEHAVIOR OF OXIDE FILMS ON SEMICONDUCTORS AND METALS

F. C. Collins, C. Chiang, L. Chen, and R. Poignant *In its* Microwave Res. Inst. Programs Nov. 1967 p 131–133 refs (See N68-16927 07-10)

Growth kinetics of thermally oxidized films and the relation between variables of thermal growth and electrical properties of the resulting films were studied for silicon dioxide, and the oxides of chromium and zirconium. Application of an electric field across the growing silicon dioxide film by means of ohmic contacts showed a linear relation between film thickness and time; the applied field enhanced the prevailing electrochemical scheme of normally occurring film growth. Transient effects were found when the applied electric field was interrupted and reapplied. A laboratory study on the effects of the introduction and measurement of trace amounts of ionic impurities is continuing. G.G.

N68-16963# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.

HOT ELECTRON GALVANOMAGNETIC CO-EFFICIENTS OF POLAR SEMICONDUCTORS

P. Das and V. Sahni *In its* Microwave Res. Inst. Programs Nov. 1967 p 133–141 (See N68-16927 07-10)
(Grant NSF GU-1557)

Hot electron galvanomagnetic coefficients of polar semiconductors were studied by analyzing the dependency of Hall mobility and magnetoresistance on the applied electric and magnetic fields and on the carrier concentration. Models were formed to determine possible nonlinear effects produced by: (1) microwave emission from InSb; (2) ultrasonic propagation and the acousto-electric field in CdS and GaSb; and (3) bulk microwave generation in GaAs, CdTe, and InP. Three different carrier concentrations were used to present inter-electronic collisions. Results showed that single valley semiconductors with high carrier concentrations and ratios of hot-electron Hall to conductivity mobilities at unity and showed zero magnetoresistance coefficients independent of the applied electric and magnetic fields. In the medium and low concentration cases for single valley semiconductors, the galvanomagnetic coefficients were highly dependent on applied fields. Numerical results are presented for polar optical phonon scattering at room and liquid nitrogen temperatures under assumed isotropic effective mass; here, magnetoresistance coefficients varied several orders of magnitude in changed magnetic fields. Dielectric breakdown depended also slightly on the magnetic field. G.G.

N68-16964# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.

MULTIPLE WAVE INTERACTIONS IN PIEZOELECTRIC SEMICONDUCTORS

R. Mauro and W. C. Wang *In its* Microwave Res. Inst. Programs Nov. 1967 p 142–144 refs (See N68-16927 07-10)
(Grant NSF GK-1257)

Three and four phonon processes in cadmium sulfide were studied by using the CdS as an ultrasonic amplifier with multiple wave interactions where nonlinear interaction of the free carriers with the electric field accompanies the acoustic wave as a result of piezoelectric coupling. Signals of 14 and 16 mhz were used to excite the input transducer and to generate the colinear acoustic CdS wave; frequencies of 28, 30, and 32 mhz were detected at the output transducer by heterodyning. Through analogy with the three wave interaction problem, it was demonstrated that the 30 mhz signal was generated by six times as many source terms as those of the third harmonics. The third harmonics at 27, 28.5, and 34.5 mhz were hardly observable because they were more than 30 db smaller than the 30 mhz interaction term. It was concluded that the obtained results confirmed the nonlinear theory of multiple wave interactions. G.G.

N68-16965# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.

ACOUSTOELECTRIC EFFECT IN BISMUTH

R. Augeri and S. J. Freedman *In its* Microwave Res. Inst. Programs Nov. 1967 p 145–151 refs (See N68-16927 07-10)

Measurements of the attenuation of longitudinal ultrasonic waves as a function of frequency (30-110 mcs) and temperature (1.5°K–300°K) have been performed along the trigonal axis of a single crystal of Bi (doped 30 ppm Te). The data exhibits attenuation peaks as a function of temperature which imply relaxation mechanisms which can be attributed to dislocations and possibly other relaxation phenomenon causing internal friction. The data also points to an electronic attenuation for Bi much lower than that reported by other authors. Author

N68-16966# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.

ENERGY BAND STRUCTURE OF GOLD

H. Schlosser *In its* Microwave Res. Inst. Programs Nov. 1967 p 151–153 refs (See N68-16927 07-10)

(Contract DA-31-124-ARO(D)-307)

The non relativistic band structure of gold was determined by composite wave variational method and preliminary calculation results were tabulated with the conduction bands plotted along various symmetry directions in the Brillouin zone. For these calculations the lattice constant was taken to equal 7.7147 a.u.; the one electron crystal potential was constructed by superposition of the numerical self consistent relativistic atomic potentials for Au. A second potential was taken into account. Results indicated that the shapes and ordering of the conduction bands in Au are relatively insensitive to exchanges in the crystal potential. G.G.

N68-17007# Illinois Univ., Urbana.

NUCLEAR MAGNETIC RELAXATION AND ATOMIC DIFFUSION IN ALUMINUM ALLOYS

Frank Yale Fradin Oct. 1967 117 p refs

(Contract AT(11-1)-1198)

(COO-1198-486) CFSTI: HC $3.00/MF $0.65

Measurements are presented of nuclear magnetic relaxation of ^{27}Al in pure aluminum and aluminum-base alloys containing either zinc, magnesium, silver, or germanium in concentrations between 0.1 and 5.0 atomic percent. From these measurements of spin lattice relaxation in the coordinate system rotating at the Larmor frequency of ^{27}Al, a composition-dependent activation energy for atomic diffusion and a composition-dependent local field strength at the aluminum nucleus is determined and related to both the nuclear dipole-nuclear dipole interaction and the nuclear electric quadrupole interaction. In pure aluminum the activation energy for diffusion was found to be 28.75 kcal/mole. The low activation energy in the alloys was interpreted in terms of easy atomic motion near a solute atom. An excess contribution to the Hahn echo T_2 measurements at temperatures below the melting point of aluminum, which has been previously reported, is not found in the relaxation time measurements in the rotating frame $T_{1\rho}$. This is explained in terms of a static quadrupole component of the local field at the aluminum nucleus which affects the T_2 measurements but not the $T_{1\rho}$ measurements. The observed dipolar contribution to the local field in pure aluminum is found to be about 20% larger than the theoretical value. Also, the field dependence of the conduction electron contribution to ^{27}Al spin lattice relaxation in the rotating frame deviates from the theoretical prediction of the field dependance. These effects have been previously reported for pure aluminum, in laboratory frame experiments. Author (NSA)

N68-17015# Naval Radiological Defense Lab., San Francisco, Calif.

ALPHA AND BETA BANDS IN LITHIUM FLUORIDE

Lewis D. Miller and Richard H. Bube 25 Oct. 1967 24 p refs

(USNRDL-TR-67-136; AD-663114)

Optical absorption bands at 9.6 and 11.3 eV have been produced in LiF single crystals by x-ray irradiation at room temperature. As the result of an investigation of the thermal bleaching of these absorption bands, they were identified respectively with the alpha- and beta-bands which have not been previously reported in LiF. Significant differences are observed in the variation of these bands relative to the F-band depending on whether thermal or optical bleaching is used. Author (TAB)

N68-17027 United Kingdom Atomic Energy Authority, Harwell (England).

TRANSITION TO SUPERCONDUCTIVITY IN SINTERED SAMPLES OF THE Nb–Sn SYSTEM

G. Meyer Apr. 1967 19 p refs Transl. into ENGLISH from Z. Physik (Berlin), v. 189, 1966 p 191–198

The inductive and resistive transitions to superconductivity were measured on samples of the Nb–Sn system with 20 and 25 percent Sn, sintered at temperatures between 700 and 1500°C. The influence of magnetic fields on the transition was studied in particular detail. The inductive transition is due to shielding currents. The anomalous rise of the transition temperature of 4Nb:1 Sn samples was found to be due to the higher critical currents of these samples. A rise of the critical fields was observed for samples sintered at low temperatures. Author

N68-17091 United Kingdom Atomic Energy Authority, Harwell (England).

THE INFLUENCE OF PRESSING AND SINTERING CONDITIONS ON THE PROPERTIES OF THERMOELECTRICAL MATERIALS

Fritz Wendler and Horst Schreiner Sep. 1966 12 p refs Transl. into ENGLISH from Z. Metallk. (Stuttgart), v. 12, no. 56, 1965 p 853–856

The thermoelectric characteristics of p- and n-conducting samples were investigated as a function of the compacting pressure between 0.5 and 3.5 tons/cm^2 and at sintering temperatures up to 550°C. The p-sides consist of 74 mol.% Sb_2Te_3, 26 mol.% Bi_2Te_3, and an addition of 0.02 to 0.03 wt.% Pb. The n-conducting sides of 80 mol.% Bi_2Te_3 doped with 0.075 wt.% CuBr and 20 mol.% Bi_2Se_3 have effectivity values of $z = 2.5$ to 2.9×10^{-3} 1/°C with compacting pressures between 3 and 3.5 tons/cm^2 and with 1 hr sintering in hydrogen between 400° and 450°C. The characteristic values of the p-conducting samples are, on the other hand, somewhat lower. Author

N68-17157# Soreq Research Establishment, Israel Atomic Energy Commission, Yavneh.

INFRARED STUDIES OF ANTIFERROELECTRIC $NH_4H_2PO_4$ TYPE CRYSTALS

E. Wiener, S. Levin, and I. Pelah Aug. 1967 20 p refs

(IA-1136)

The antiferroelectric phase transition in $NH_4H_2PO_4$ was studied by measuring the infrared absorption spectra (250 to 4000 cm^{-1}) in both phases. The changes in the spectrum occurring on crossing T_c, were compared with those found earlier in the ferroelectric transition of KH_2PO_4. The appearance of more lines in the antipolar phase led to the conclusion that in this phase the

hydrogens are arranged asymmetrically along the c axis, thus inducing an antiparallel dipole arrangement. The infrared absorption spectrum of a mixed crystal $NH_4H_2Po_4$: $NH_4H_2AsO_4$ was measured at different temperatures in order to test the validity of the site group assignments in these crystals. Prominent changes were observed in the spectra of $ND_4D_2PO_4$, $NH_4H_2AsO_4$, and $ND_4D_2AsO_4$ on crossing the antiferroelectric Curie point. Author (NSA)

N68-17159# Puerto Rico Nuclear Center, San Juan.
F CENTER FORMATION AT 78°K IN KBr DURING EXPOSURE TO MONOCHROMATIC X-RAY ENERGIES AROUND THE BROMINE K EDGE
Baltasar A. Cruz Vidal (Ph.D. Thesis—Harvard Univ., Cambridge) May 1967 124 p refs
(Contract AT(40-1)-1833)
(PRNC-106) CFSTI: HC $3.00/MF $0.65

In KBr irradiated at 78°K the rate of formation of F centers per unit energy retained in the crystal was found to be the same whether 13.4 keV or 14.1 keV was the incident photon energy (the K edge of bromine is at 13.5 keV). In other words, at either incident photon energy the energy expenditure per F center formed was 1.21×10^3 eV±4.4%. This result indicates that K-shell ionization in bromine does not affect the mechanism of formation of F centers in KBr. However, a large background to multiply ionized atoms is expected whether the incident photon energy is 13.4 keV or 14.1 keV. Each of these atoms becomes multiply ionized after losing an electron in the L shell. Thus, in a bromide the equality of the rate of formation of F centers above and below the K edge is not sufficient evidence to conclude that a Varley mechanism of F center formation is not operative. Each of the monochromatic beams was the fluorescent output of RbCl filtered with a thin layer of NaBr or of $Sr(NO_3)_2$ filtered with RbCl. Author (NSA)

N68-17168 European Organization for Nuclear Research, Geneva (Switzerland).
PRECISE MEASURE OF WEAK MAGNETIC FIELDS. LONG TERM STABILITY OF PERMANENT MAGNETS AND OF THE HALL EFFECT [MESURE PRECISE DES CHAMPS MAGNETIQUES FAIBLES STABILITE A LONG TERME DES AIMANTS PERMANENTS ET DE L'EFFET HALL]
J. F. Labeye, J. Leroux, and A. Maurer Nov. 1967 72 p refs
(CERN-67-32)

A Hall effect measuring device was realized that is capable of measuring nonhomogeneous magnetic fields at 120 gauss with a resolution on the order of $\pm 5.10^{-5}$ and a long-term stability of about $\pm 2.10^{-4}$. A study of Hall behavior was made, and the stability limits as well as the processes of stabilization were determined. These results permit the use of the Hall effect to measure weak fields with considerably more precision than was previously possible; and with some modifications the device can be used to measure superconducting magnets. Conditions imposed on the measurements are discussed, and the choice of measurement methods is reviewed. Stability of permanent magnets is considered, the reference magnet is described, and amplification methods and thermal regulation are discussed. Transl. by M.W.R.

N68-17209# Northwestern Univ., Evanston, Ill. Dept. of Materials Science.
STRUCTURE SENSITIVE PROPERTIES OF INTERMEDIATE SOLID SOLUTIONS Final Report, 1 Sep. 1963–31 May 1967
J. O. Brittain 10 Nov. 1967 12 p refs
(Grant AF-AFOSR-466-64)
(AFOSR-67-2790; AD-662614)

The report is concerned with an investigation of the effects of point defects on various physical and optical properties of the intermetallic compounds NiAl, CoAl, NiGa, and CoGa. The optical properties of NiAl, CoAl, NiGa, and CoGa indicate that some of these alloys show free electron like behavior for photon energies below about 1 eV, but that others do not. The optical absorption bands that occur in NiAl at about 1 - 2 eV, 2.5 eV, 4.0 eV, and 5 eV have been associated with interband transitions and have been interpreted by the use of a simple rigid band model. CoAl, CoGa and NiGa alloys had an absorption band at 4.0 eV and CoAl and NiGa also had an absorption band at 1 - 2 eV. The 4.0 eV peak was common to all alloys and independent of composition, although the peak position varied slightly in photon energy from one alloy system to the next. The amplitude of the 2.5 eV band in NiAl was strongly compositionally dependent. The electrical resistivities of NiAl, CoAl, NiGa, and CoGa, measured as functions of temperature and composition indicate that these materials are metallic in nature, that the point defects are very important to the conductivity process, and that clustering of the point defects occurs when the composition departs from stoichiometry. Results from measurements of the Hall coefficient and the transverse magneto-resistance in NiAl indicate that a two band model may be necessary to explain the transport processes in NiAl. Author (TAB)

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N68-16344*# Jet Propulsion Lab., Calif. Inst. of Tech., Cambridge.
THE STATUS OF MONOPROPELLANT HYDRAZINE TECHNOLOGY
T. W. Price and D. D. Evans 15 Feb. 1968 24 p refs
(Contract NAS7-100)
(NASA-CR-92742; JPL-TR-32-1227) CFSTI: HC $3.00/MF $0.65
CSCL 21I

The use of hydrazine as a monopropellant for thrustars and gas generators has several outstanding advantages. The associated systems are simpler, as compared to bipropellant systems, and the exhaust products are *clean* and relatively cool, allowing utilization of simple, radiation-cooled decomposition chambers. The development of the Shell 405 catalyst, which spontaneously initiates hydrazine decomposition at room temperature, has greatly increased the interest in monopropellant hydrazine systems. This report gives a brief account of the history of hydrazine as a monopropellant, as well as a few comments on the handling and physical properties of the propellant. The major emphasis, however, is given to a comprehensive survey of the current status of this technology, including catalyst availability and handling, reactor design and operation, system considerations, and the limitations and problems of monopropellant hydrazine. The current and anticipated applications are described, and a brief account of non-propulsion applications is included. Finally, current work relative to new catalysts and propellant additives is summarized. Author

N68-16590# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany).
A HISTORICAL REVIEW OF DEVELOPMENT IN PROPELLANTS AND MATERIALS FOR ROCKET ENGINES
O. Lutz Sep. 1967 17 p Presented at the 18th Intern. Congr., Belgrade, Sep. 1967
(DLR-FB-67-78; DK-621.455)

Work done in the field of rocketry some 30 years ago in Germany is reviewed. The main efforts were directed to the right choice of propellant combinations and led to a series of different "Ergoles" (Monergoles, Lithergoles, and Hypergoles). Problems of the mechanism of ignition related to special designs of mixing injectors also have been points of development. The survey includes remarks on special materials, and cermets for rocket nozzles. Author

N68-16788*# Rocketdyne, Canoga Park, Calif.
LITHIUM–FLUORINE–HYDROGEN PROPELLANT STUDY Final Report
H. A. Arbit, R. A. Dickerson, S. D. Clapp, and C. K. Nagai 22 Feb. 1968 344 p refs
(Contract NAS3-7954)
(NASA-CR-72325; R-7257) CFSTI: HC $3.00/MF $0.65 CSCL 21I

Results of a program encompassing an analytical, design, and experimental effort to establish the fundamental feasibility of the fluorine/lithium/hydrogen tripropellant combination are reported. This effort comprised: (1) a thermodynamic-kinetic analysis of the Li/F_2H_2 system, including theoretical performance calculations, (2) studies of liquid-metal atomization and combustion, (3) design and buildup of a liquid-lithium (LLi) facility, (4) design of thrust chamber, including a fluorine-rich, hydrogen-fluorine gas generator and two lithium injectors, and (5) experimental firings of $LF_2/LLi/GH_2$. The test matrix covered a range of chamber pressure (350 to 520 psia), F_2Li mixture ratio (2.4 to 5.2), and proportion of hydrogen (15 to 44 percent of total flowrate), and included variations in point of hydrogen addition and in chamber length. Corrected characteristic velocity efficiencies were 95 to 100 percent, showing that use of this tripropellant combination is feasible and that highly efficient combustion can be achieved. Author

N68-17093*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FEASIBILITY OF SUPPORTING LIQUID FUEL ON A SOLID WALL IN A RADIATING LIQUID-CORE NUCLEAR ROCKET CONCEPT
Henry A. Putre and Albert F. Kascak Washington Feb. 1968 29 p refs
(NASA-TN-D-4413) CFSTI: HC $3.00/MF $0.65 CSCL 21F

A reference liquid fuel nuclear rocket concept, previously analyzed, consists of a liquid carbide fuel mixture supported on the inside wall of a rotating tube. This report extends the original liquid fuel heat-transfer analysis for the reference engine by developing an expression for combined molecular and propellant induced turbulent heat transfer in the liquid fuel, and results in a more rigorous determination of support-wall temperature. In addition, two means of reducing support wall temperature without severly affecting rocket performance are investigated. For the reference fuel element configuration, with uniform heat source distribution in the liquid fuel, the support wall temperature calculated from the more complete turbulent analysis was 9830°R (5460°K). When the fuel was zoned into a region in the liquid near the propellant interface, the support wall temperature was about 1200°R (670°K) lower than for the unzoned case. A simplified mass-transfer analysis indicated that wall temperature reduction by fuel zoning does not appear feasible. The insulating effect of a stable opaque vapor layer built up at the solid liquid interface was also evaluated. Wall temperature was found to be reduced to 8500°R (4720°K) at 1430 seconds specific impulse by the vapor layer. Current wall materials, such as graphite used at 7200°R (4000°K) in conjunction with an opaque vapor layer, may permit operation at a reduced specific impulse of about 1250 seconds. Author

N68-17187# Stevens Inst. of Tech., Hoboken, N. J. Dept. of Mechanical Engineering.
INVESTIGATION OF THE AMMONIUM PERCHLORATE COMPOSITE PROPELLANT DEFLAGRATION MECHANISM BY MEANS OF EXPERIMENTAL ANALOG TECHNIQUES
Robert F. McAlevy, III, Suh Yong Lee, Frank A. Lastrina, and Norman A. Samurin Sep. 1967 93 p refs
(Contract Nonr-263(48))
(ME-RT-67006; AD-663132)

Two types of experimental, analogue burners were developed and employed for the purpose of evaluating theoretical models of composite propellant deflagration. One type, the porous-plug burner, involves a bonded porous ammonium perchlorate (AP) bed burning with a fuel gas throughput; similarly porous fuel beds may be burned with oxidant gas throughputs. The other type the loose-granule burner, involves mixtures of solid AP and fuel granules burned without a gas throughput. These analog burners allow evaluation of parametric influences including fuel and oxidant initial physical phase, system chemistry, and oxidant and fuel granularity scales. Experimental results from the two analog burners suggest that deflagration rates depend on the spatial distribution of energy release rate and not on overall energy release alone. Loose-granule burner deflagration is shown to be an excellent, if not perfect, analog of actual propellant deflagration; experiments with the burner show that fuel-binder pocket size in propellants may play a strong role in propellant deflagration. In some burning regimes the loose granule burner suffers from interstitial burning and the porous-plug burner deflagration is influenced by the granule-bonding technique used. This latter fact forces re-examination of the work of others in using such burners to infer stoichiometrically-correct mixture ratios from deflagration rate-mixture ratio burning characteristics. Author (TAB)

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N68-16184# Deutsche Forschungsanstalt fur Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Strahlantriebe.
INVESTIGATION OF THE PERFORMANCE OF AIRBORNE SEPARATION DEVICES [UNTERSUCHUNG UEBER DEN BETRIEB FLIEGENDER LUFTTRENNUNGSANLAGEN]
Gisela Stoffers Aug. 1967 35 p refs In GERMAN; ENGLISH summary
(DLR-FB-67-79)

The performance is investigated of air separation devices that, attached to air-breathing engines of space vehicle boosters and using their liquid hydrogen fuel as coolant, are to extract liquid oxygen from a part of the combustion air for use in additional rocket propulsion. Measures to improve the output make most sense at the low temperature end of the process, especially around the temperature of the air at gaseous boiling. Low hydrogen pressure and high air pressure in this range look advantageous. The separation unit should be capable of complete recovery of the oxygen contained in the liquified air. Author

N68-16273*# Israel Program for Scientific Translations, Ltd., Jerusalem.
RUSSIAN SOLID FUEL ROCKETS
V. N. Sokol'skii 1967 239 p refs Transl. into ENGLISH of the book "Rakety na Tverdom Toplive v Rossii" Moscow, Izd. Akad. Nauk SSSR, 1963 p 1-236 Published for NASA and NSF
(NASA-TT-F-415; TT-66-51152) CFSTI: HC $3.00/MF $0.65 CSCL 21H

A historical review is presented of all solid-fuel rocket development in Russia prior to 1917. Included are the following: (1) early pyrotechnic rockets and military rocket applications; (2) design and production facilities for military rockets; (3) attempted rocket aircraft designs; and (4) historical events and milestone designs in rocket development. An extensive bibliography is also included. K.W.

N68-16396*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
A CRITICAL REVIEW OF THE MAGNETOPLASMADYNAMIC (MPD) THRUSTOR FOR SPACE APPLICATIONS
Noble M. Nerheim and Arnold J. Kelly 15 Feb. 1968 118 p refs
(Contract NAS7-100)
(NASA-CR-93139; JPL-TR-32-1196) CFSTI: HC $3.00/MF $0.65 CSCL 21C

A comprehensive review of the published performance data and proposed acceleration mechanisms of the magnetoplasmadynamic (MPD) plasma accelerator has been made to estimate its capacity to operate in a spacecraft propulsion system. The ability of the MPD thrustor to perform a specific space mission is compared with that of the ion engine for a Mars-orbiter mission. This comparison is based primarily on the reported performance data; however, other required characteristics, such as lifetime, reliability, compatibility with a solar electric power supply, and the associated weight requirements of the power-conditioning equipment, are discussed. The best results have been obtained with lithium, ammonia, and hydrogen. The definition and attainment of the proper test environment remain one of the biggest problems. No reliable method exists to determine whether or when entrainment occurs. In spite of the uncertainties associated with the MPD engine, it may be concluded that the ion engine operates more efficiently than the MPD, with the possible exception of operation at a specific impulse of less than 300 s. If the MPD thrustor is to compete with the ion engine, the weight savings gained with the MPD must be enough to offset the ion engine's higher overall efficiency. Author

N68-16413*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
COLD-AIR PERFORMANCE EVALUATION OF SCALE MODEL OXIDIZER PUMP-DRIVE TURBINE FOR THE M-1 HYDROGEN-OXYGEN ROCKET ENGINE. 3: PERFORMANCE OF FIRST STATE WITH INLET-FEEDPIPE-MANIFOLD ASSEMBLY
Roy G. Stabe and John F. Kline Washington Feb. 1968 21 p refs
(NASA-TN-D-4392) CFSTI: HC $3.00/MF $0.65 CSCL 21H

The aerodynamic performance of the first stage of a 0.45-scale model of the oxygen pump-drive turbine for the M-1 rocket engine was determined experimentally. The first stage, including the inlet-feedpipe-manifold assembly, was tested over a range of speeds and pressure ratios. The results indicated that, at design equivalent speed and blade-jet speed ratio, the first-stage static and total efficiencies were very close to design values. The static and total efficiencies were 0.37 and 0.57 compared with the design values of 0.375 and 0.563, respectively. The equivalent weight flow at the design point was the same as that reported for the reference two-stage turbine investigation. The weight flow was reduced by a higher-than-design inlet-manifold total-pressure loss, a large circumferential variation in manifold flow conditions, and a 3.7-percent deficit in nozzle throat area. The less-than-design throat areas changed the static-pressure distribution from design and reduced the nozzle-exit velocity. Results of a velocity diagram and a loss analysis of the first-state performance indicated that the rotor efficiency was 0.81 compared with the design value of 0.80. The nozzle performed better than design; the nozzle efficiency was 0.94 compared with the design value of 0.91. Author

N68-16426*# Bell Aerosystems Co., Buffalo, N. Y.
INVESTIGATION OF ADVANCED THRUST CHAMBER DESIGNS
C. H. Brown Feb. 1968 169 p refs
(Contract NAS3-7968)
(NASA-CR-72320; BAC-8489-945001) CFSTI: HC $3.00/MF $0.65 CSCL 21H

This program is directed towards developing advanced designs and fabrication techniques for regeneratively cooled rocket thrust chambers. The selected design show promise of reducing fabrication cost and time, reducing heat flux to the coolant, and increasing thrust chamber life. Detailed design studies and analyses led to the selection of TD nickel for the inner liner material. The inner linear contains the coolant flow channels which are produced by electrical discharge machinging. The outer shell is produced by electroforming nickel on the lands of the inner liner. Various design configurations consisting of tubular and milled channel flow passages were analyzed and compared. An extensive material study was conducted comparing the advantages and disadvantages of refractory metals, superalloys, and dispersion hardened alloys. Alternate fabrication methods for the inner liner, coolant passages and outer structural shell were evaluated i.e., High Energy Rate Forming (HERF), spinning and conventional forming. Chemical milling, electrochemical milling, electro discharge machining and conventional milling were compared for producing the flow passages. Electroforming, diffusion bonding, explosive welding, conventional welding and brazing were evaluated for the outer structural shell. Author

N68-16477* Thiokol Chemical Corp., Brunswick, Ga. Space Booster Div.
THIOKOL 260-SL CASE DEVELOPMENT PROGRAM
18 Jan. 1966 52 p
(Contract NAS3-6285)
(NASA-CR-54871; SBR-89.865) CFSTI: HC $3.00/MF $0.65 CSCL 21H

The 260-SL-1 case was designed and fabricated using the monolithic roll-and-weld fabrication concept. The case material selected and used was air melt, 18-percent nickel maraging steel. Hydrostatic pressure test of the case resulted in a catastrophic failure at approximately 56 percent of proof pressure. Failure was initiated at one or both of two weld defects in a longitudinal seam in the aft cylinder. Work in conjunction with failure analysis shows that submerged arc welding as performed under this program does not provide adequate fracture toughness for large rocket motor cases using 250-ksi grade maraging steel. Author

N68-16479*# Thiokol Chemical Corp., Brunswick, Ga. Space Booster Div.
THIOKOL 260-SL NOZZLE DEVELOPMENT PROGRAM
[1967] 183 p
(Contract NAS3-6285)
(NASA-CR-54870; SBR-90.865) CFSTI: HC $3.00/MF $0.65 CSCL 21H

Static test of the 156-2C-1 rocket motor provided useful data on the design, ablative materials, and fabrication techniques

used in the manufacture of the nozzles for the 156- and 260-inch diameter solid propellant rocket motors. Nozzle erosion rates were higher than predicted, however, demonstration of a tape-wrapped ablative, steel-jacketed nozzle for a three-million pound thrust solid-propellant rocket motor was considered a success. The nozzle test also demonstrated that facilities exist that are suitable for manufacture of tape-wrapped ablative components for use in nozzles of this size. The assembly and shipping of the nozzle proved that a method of handling can be devised for such large ablative structures. Author

N68-16545# Royal Aircraft Establishment, Farnborough (England).
SUCTION LOSSES OF SHARP-LIP AIR INTAKES [ANSAUGVERLUSTE BEI SCHARFLIPPIGEN LUFTEINLAESSEN]
E. Soeffker and A. Renner Aug. 1967 27 p refs Transl. into ENGLISH from Ger. Rept. No. DLR-FB-65-26, 1965
(RAE-LIB-TRANS-1246) CFSTI: HC$3.00/MF$0.65

Graphs are presented for calculating thrust and flight performance of air-breathing engines with sharp-lip supersonic intakes. These graphs permit estimation of the pressure recovery at static and low flight Mach number conditions. Consistent with two flow-model configurations representing the intake duct, total pressure ratio may be directly read as a function of the diffuser discharge Mach number. The main parameter concerned is the area ratio of the diffuser. Comparison with values measured on various intakes indicates that the graphs presented appear to be well suited for general estimation purposes. For the case of limited additional air mass flow, the method given can also be considered as substantiated. Author

N68-16632*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COLD-AIR INVESTIGATION OF A TURBINE FOR HIGH-TEMPERATURE ENGINE APPLICATION. 2: DETAILED ANALYTICAL AND EXPERIMENTAL INVESTIGATION OF STATOR PERFORMANCE
Herman W. Prust, Jr., Harold J. Schum, and Frank P. Behning Washington Feb. 1968 45 p refs
(NASA-TN-D-4418) CFSTI: HC$3.00/MF$0.65 CSCL 21E

The effects on turbine stator performance of the blade features of low solidity and large profile and trailing-edge thicknesses were studied. At design mean-section critical velocity ratio of 0.790, the experimental results for the subject stator based on annular-sector data show an annular-sector, after-mix, kinetic-energy loss coefficient of approximately 0.05. The experimental performance of this stator was compared with the estimated performance of two stators with thinner profiles and higher solidities than the subject blading. This comparison indicated that the performance of the subject blading was not significantly affected by increased profile thickness, and that the mean-radius solidity of the subject blading of 1.39 was not too low for good performance. Good agreement was obtained between experimental and analytical mean-section performance for the subject stator and one of the reference stator bladings. These analytical results indicate that the large trailing-edge blockage of the subject stator (about 10 percent) caused a 1% loss of the kinetic energy available to the stator. Rather poor agreement was obtained for the subject stator between experimental annular-sector loss and annular-sector loss predicted from mean-section data. The after-mix kinetic energy loss coefficient obtained from radial integration was 0.010 larger than the predicted value at design critical velocity ratio. Author

N68-17028*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
INVESTIGATION OF A LARGE-SCALE MIXED COMPRESSION AXISYMMETRIC INLET SYSTEM CAPABLE OF HIGH PERFORMANCE AT MACH NUMBERS 0.6 TO 3.0
Norman E. Sorensen and Donald B. Smeltzer Washington Feb. 1968 180 p refs
(NASA-TM-X-1507) CFSTI: HC$3.00/MF$0.65 CSCL 21H

A model of a mixed-compression inlet with a 20 inch diameter capture area was designed and tested in combination with three subsonic diffuser designs. The major objective was to investigate relatively short axisymmetric inlet systems capable of high performance over the complete Mach number range. The model was tested in a wind tunnel at Mach numbers from 0.6 to 3.2 and angles of attack from 0° to 8°. The Reynolds number was about 2×10^6 per foot at Mach number 3.0. The supersonic diffuser of the inlet was designed with the aid of a computer program employing the method of characteristics. Preliminary tests showed that the supersonic portion of the inlet performed as predicted, but the flow separated in the subsonic diffuser limiting the performance at the engine face. The subsonic diffuser was then modified and the total pressure recovery was raised to 90% with about 11% boundary layer bleed mass flow from 86% recovery with 13-percent bleed. Off-design total-pressure recoveries were also improved about 4% over the Mach number range 1.55 to 3.0. The 1.50 capture diameter inlet, with vortex generators, showed an additional 1-percent improvement in recovery, but of more significance was the reduction in total pressure distortion at the engine face. The distortion was reduced to 6 to 7% from about 10% and the maximum recovery was improved to about 91% with about 11% boundary layer bleed mass flow. Without the generators the distortion of the 1.50-diameter inlet was about doubled (14%). The test results in the Mach number range 0.6 to 1.2 included details of experimentally measured additive drag. It was found that there was an optimum trade of additive drag for pressure recovery. Author

N68-17081*# Vickers, Inc., Troy, Mich. Research and Development Dept.
INVESTIGATION OF GASEOUS SECONDARY INJECTION THRUST VECTOR CONTROL CONSIDERING PRIMARY NOZZLE OVEREXPANSION, FREQUENCY RESPONSE, AND INJECTION ANGLE
Jan. 1968 109 p refs
(Contract NAS1-7154)
(NASA-CR-66533) CFSTI: HC$3.00/MF$0.65 CSCL 21H

The performance characteristics of gaseous secondary injection thrust vector control in overexpanded primary nozzles are investigated under sea-level conditions. Nitrogen gas is used in both the primary and secondary systems. Four interchangeable primary nozzles with 6.79, 10.72, 16.56, and 25.00 area ratios provide a wide range of test conditions. Data plots incorporating the effects of total and differential flow rates from two opposed injection nozzles provide criteria for predicting performance of a vehicle whose primary nozzle is overexpanded relative to the ambient pressure. Frequency response and injection angle characteristics are determined for secondary injection thrust vector control in a primary nozzle with sea-level expansion. Author

N68-17122# Association Internationale des Constructeurs de Materiel Aerospatial, Paris (France).
PRESENT-DAY ENGINES AND FUTURE ENGINE DEVELOPMENT
Denning Pearson (Rolls-Royce, Ltd., Derby (England)) Sep. 1967 14 p Presented at AICMA Symp., London, Sep. 1967 *Its* Paper No. 4

The activities of aircraft manufacturers in Great Britain, France, Belgium, Germany, Italy, and Sweden are reviewed, and emphasis is placed on the fact that the biggest problem Europe faces is the fragmentation of its aero-engine industry at a time when the resources needed to compete effectively are growing

rapidly. The need for closer relations between small and large companies on an international scale is stressed. Expansion in the civil market is discussed in terms of economic advances and technical progress, and the interchange between military and civil applications of engine designs. The European engine industry is considered competitive technically with United States companies, but a challenge to management policies is seen. The strong recommendation is made that programs with the greatest market potential be undertaken and managed so that the engines are developed as rapidly as those of competitors, supported effectively in service, and produced at competitive cost. M.G.J.

N68-17198*# Thiokol Chemical Corp., Brunswick, Ga. Space Booster Div.

THIOKOL 260-SL SUBSCALE NOZZLE VERIFICATION PROGRAM; 65-SS-2 AND 65-SS-3 MOTORS

18 Jan. 1966 71 p refs

(Contract NAS3-6285)

(NASA-CR-54869; SBR-88.865) CFSTI: HC $3.00/MF $0.65 CSCL 21H

The successful static test of the 65-SS-2 rocket motor demonstrated the acceptability of the basic nozzle design, the nozzle materials, and the ablative tape fabrication concepts which had been used in the design of the nozzles for the 156- and 260-inch rocket motors. Other program items verified by this motor test were the propellant, case insulation, flap filler material, and the liner. The entrance section of the nozzle was also used to test varying thicknesses of V-44 insulation and V-61 joint filler. The referenced specific impulse of the propellant was calculated to have a value of 244.8 lb-sec/lb. The successful performance of the 65-SS-3 motor reconfirmed the adequacy of the ablative insulation materials, fabrication processes for the nozzle, propellant, liner, and case insulation, as well as proved that the changes which had been made in the nozzle design based on the 65-SS-2 motor performance were satisfactory. Author

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N68-16118*# American Science and Engineering, Inc., Cambridge, Mass.

RESULTS OF A SOUNDING ROCKET EXPERIMENT TO STUDY GALACTIC X-RAY SOURCES Final Report, 29 Mar.–8 Dec. 1967

1 Dec. 1967 90 p refs

(Contract NASw-1583)

(NASA-CR-80280; ASE-1762) CFSTI: HC $3.00/MF $0.65 CSCL 03B

To obtain information on galactic X-ray sources, an X-ray astronomy experiment was flown on the Aerobee rocket. The objectives were to determine whether any X-ray sources could be identified with optical objects, to localize the X-ray sources grouped on the Sgr–Sco region of the Milky Way and to obtain spectral information on the X-ray emission of the sources. The tests conducted were an X-ray survey of the Cygnus Region, an optical search for the X-ray sources Cyg X-1 and Cyg X-2, distribution of galactic X-ray sources from Scorpio to Cygnus, and the spectra of several X-ray sources in Cygnus and Scorpio. An analysis of data show: (1) Cygnus A was not observed to emit X-rays, and none of the recorded X-ray sources coincided with any outstanding single objects in the area. (2) A candidata object was found for Cyg X-2 that has many of the optical properties of Sco X-1. The analyzed data from the observed spectra showed a deficiency of photons at low energy that could only be interpreted as absorption effects. B.S.D.

N68-16270*# Massachusetts Inst. of Tech., Cambridge. Center for Space Research.

A STATISTICAL RAY ANALYSIS OF THE SCATTERING OF RADIO WAVES BY AN ANISOTROPICALLY TURBULENT, NON-HOMOGENEOUS SOLAR CORONA

Joseph V. Hollweg (Ph.D. Thesis) 27 Sep. 1967 236 p refs

Sponsored in part by Hughes Aircraft Co.

(Contract NASr-249; Grant NsG-496)

(NASA-CR-92698; CSR-T-67-6) CFSTI: HC $3.00/MF $0.65 CSCL 03B

The scattering of radio waves by an anisotropically turbulent solar corona showing large refraction effects is discussed in terms of a statistical ray analysis. The ray equations of geometrical optics are written in terms of the spherical coordinate system natural to the solar corona, and discussed for the cases of a spherically symmetric average corona and an anisotropically turbulent corona. For the urbulent corona, a linear perturbation analysis is used to obtain quadrature solutions for the statistical fluctuations in the ray position, signal phase, and pulse propagation time for a corona exhibiting large scale refraction. The expressions obtained are discussed for the special case of nearly linear rays. At appropriate frequencies even very slight ray curvatures are shown to affect the fluctuations in the propagation times of pulse signals across the corona. An attempt is made to provide an analytical framework for interpreting observed fluctuations in the signal angle of arrival, fluctuations in the arrival times of pulse signals, and variations in the signal bandwidth. The discussion concludes with a discussion of scattering data available at present. Author

N68-16276*# National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York.

HYDROGEN AND HELIUM ABUNDANCES IN NEUTRON STAR ATMOSPHERES

Leonard C. Rosen [1966] 30 p refs

(NASA-TM-X-60843) CFSTI: HC $3.00/MF $0.65 CSCL 03B

The question whether one may identify a neutron star by observing hydrogen and helium lines in its spectra is examined. An analysis is presented of the burning and diffusion of hydrogen and helium in a neutron star atmosphere. An initial two-component atmosphere of hydrogen and carbon and of helium and carbon is examined utilizing various photospheric temperatures. The hydrogen burns through the proton–proton reaction and the CN cycle, and the helium by the triple alpha process and alpha capture on carbon. It is found that only a negligible proportion of hydrogen or helium can exist after a few years in the neutron star atmosphere. Therefore spectra which include hydrogen and helium lines cannot be attributed to neutron stars. Author

N68-16444# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.

FRAGMENTATIONS OF COSMIC RAY NUCLEI WITHOUT PARTICLE PRODUCTION AT THE ENERGY RANGE 10 TO 1000 GeV/NUCL [FRAGMENCJE JADER PROMIENIOWANIA KOSMICZNEGO BEZ PRODUKCJI CZASTEK PRZY ENERGII OD 10–1000 GeV/NUKL]

Krzysztof Rybicki 1967 8 p refs

(INR-792/6/PH)

The 34 interactions in which primary nuclei of cosmic radiation break up without visible particle production are described. This process was observed for Z_{inc}=2–9 nuclei at energies ranging from 10 GeV/nucl to some TeV/nucl. In majority of cases there are not tracks of low-energy particles coming from the target nucleus. These events are well interpreted in terms of photodisintegration of incident nucleus by photon from the Coulomb field of heavy emulsion nucleus (Ag, Br). The remaining events correspond to collisions with light emulsion nuclei (H, C, N, O) and are connected with strong interactions. Author (NSA)

N68-16483*# Chicago Univ., Ill. Enrico Fermi Inst. for Nuclear Studies.
HIGH ENERGY ELECTRONS AND EMISSION OF THE OMNIDIRECTIONAL SYNCHROTRON RADIATION IN RADIO FREQUENCY AND X-RAY REGIONS
Satya Dev Verma Jun. 1967 19 p refs
(Grant NsG-179-61)
(NASA-CR-92705; EFINS-67-48) CFSTI: HC $3.00/MF $0.65 CSCL 20H

The recent measurements of the flux and differential energy spectrum of primary electrons in the 0.2 BeV to 300 BeV energy region made near the recent solar minimum period (1966) are summarized. These measurements are consistent with a change in the exponent of the power law spectrum of primary electrons from 1.6±0.15 to 2.6±0.15 at about 2 to 5 BeV. It is pointed out that the observations of the omnidirectional intensity and the spectrum of the nonthermal radio frequency background radiation above 200 MHz are consistent with this steepening of the electron energy spectrum. Furthermore radio observations in the 10 MHz to 100 MHz region are in agreement with the lower energy electron spectrum corresponding to these radio frequencies (0.2 to 2 BeV) within 50%. This indicates that the residual solar modulation of electrons in the 0.2 to 2 BeV energy region is not large. If it is assumed that the electron energy spectrum extends in the form of a power law up to about $\approx 10^5$–10^6 BeV with the exponent (2.6, 2.8, or 3.0), then the synchrotron emission of these ultra high energy electrons would contribute to the recently observed diffuse component of cosmic X-rays although it does not completely account for the large flux. This assumed electron spectrum would also give a possible explanation for the observation of a small number of air showers which may have been produced by the electron or photon component of the primary cosmic rays. Author

N68-16503# Los Alamos Scientific Lab., N. Mex.
SOLAR WIND OBSERVATIONS
J. H. Coon [1967] 27 p refs Presented at Conf. on Earth's Particles and Fields, Freising, Ger. Sponsored in part by ARPA
(Contract W-7405-ENG-36)
(LA-DC-8944; CONF-670825-1) CFSTI: HC $3.00/MF $0.65

Vela-2 and Vela-3 satellite observations of the solar wind in the region of space near the Earth are summarized. The results include information on bulk velocity of the plasma, transverse temperature, temperature anisotropy, interplanetary magnetic field, flow direction, and alpha particles in the solar wind. NSA

N68-16518*# Stanford Univ., Calif. Radioscience Lab.
A RADAR INVESTIGATION OF THE SOLAR CORONA
John E. Ohlson Aug. 1967 95 p refs
(Grants NsG-377, NSF GP-2711)
(NASA-CR-92995; SU-SEL-67-071; SR-1; SR-21) CFSTI: HC $3.00/MF $0.65 CSCL 03B

Experiments were conducted to obtain information on several measurable radar parameters at 25 MHz, and to compare these data with previous results obtained at 38 MHz and 26 MHz. The radar characteristics of the sun are defined, and details are given on the solar radar system. A model of the time-varying reflectivity of the corona is developed in terms of its effect upon measurement of the average reflectivity (i.e., radar cross section). This is incorporated into an overall model of the fluctuating signal problem which includes the effect of random signal polarization changes due to Faraday rotation in the ionosphere and/or corona. The effects of fading and a variable coronal reflectivity upon the measurement of the solar cross section are evaluated. Extensive evidence is given to show that the radar system functioned properly during the experiments. Although the results of the experimental work were negative, it was felt that some positive conclusions were implied. These include: (1) The average radar cross section of the sun is less than two units of photospheric disk area. (2) The radar cross section at 25 MHz, at least during sunspot minimum, is not significantly greater than at 38 MHz. M.G.J.

N68-16636# Technical University of Wroclaw (Poland). Astronomical Observatory.
TABLES OF PROFILES OF THE MEAN INTENSITY PHOTOSPHERIC RADIATION IN Hα LINE FOR THE MOVING PROMINENCES
Bogdan Rompolt 1967 91 p refs *Its* Acta Univ. Wratislaviensis, No. 75; Mat., Fiz., Astron. 7; Wroclaw Astron. Obs., No. 15
CFSTI: HC $3.00/MF $0.65

The profiles of the mean intensity of photospheric Hα radiation are tabulated according to the parameters of height, velocity, and direction of the motion of the prominence. The prominence is understood to be a small, optically thin element, moving in the solar corona. Equations are derived to define the factors influencing the variation of the form and position of all contributing profiles of lines emitted by the individual surface elements, such as the Doppler shifts and the limb darkening effect. M.G.J.

N68-16723*# Minnesota Univ., Minneapolis. School of Physics and Astronomy.
PROTON AND HELIUM NUCLEI COSMIC RAY SPECTRA AND MODULATIONS BETWEEN 100 AND 2,000 MeV NUCLEON
Jonathan F. Ormes (Ph.D. Thesis) Dec. 1967 94 p refs
(Grant NsG-281-62)
(NASA-CR-92991; CR-109) CFSTI: HC $3.00/MF $0.65 CSCL 20H

Convolution techniques are used to unfold the Landau fluctuations in energy loss thereby allowing derivation of the differential energy spectrum from 100 MeV/nucleon up to 2 BeV/nucleon. The differential energy spectra derived by this technique are presented from nine balloon flights, five at Fort Churchill, Canada and four at latitudes ranging from Ely, Minnesota to Fayetteville, Arkansas. The spectra at lower latitudes clearly show the effects of the geomagnetic cut-off. The data is examined to determine the functional form of the solar modulation by comparing the sunspot minimum spectrum obtained in 1965 with the pre-sunspot minimum spectrum obtained in 1963 and the post sunspot minimum spectrum obtained in 1966. Author

N68-16792*# Volt Technical Corp., Washington, D. C.
RELATIONSHIP BETWEEN THE GEOMAGNETIC ACTIVITY AND THE ENERGY DENSITY OF QUIET SOLAR WIND FLUX [SVYAZ' GEOMAGNITNOY AKTIVNOSTI S PLOTNOST'YU POTOKA ENERGII SPOKOYNOGO SOLNECHNOGO VETRA]
I. V. Kovaleskiy 9 Feb. 1968 6 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 7, no. 6, 1967 p 982–984
(Contract NAS5-12487)
(NASA-CR-93065; ST-IMF-GM-10872) CFSTI: HC $3.00/MF $0.65 CSCL 03B

According to data of IMP-1 on the sectorial structure of the interplanetary magnetic field, apparently representing a quiet solar wind, estimates are made of energy fluxes of directed motion of thermal and electromagnetic energy incident upon the cross-section of the magnetosphere. It is shown that there are enough energy fluxes of each kind separately even for the creation of the entire complex of geophysical events in a period of moderate magnetic storm. The character is investigated of the link between the three-hourly values of the K_p-index of geomagnetic activity or the amplitudes a_p equivalent to them, with the flux densities of the various forms of energy. Author

N68-16837*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
AN ANALYSIS OF ENERGETIC SPACE RADIATION AND DOSE RATES
M. O. Burrell, J. J. Wright, and J. W. Watts Washington Feb. 1968 63 p refs
(NASA-TN-D-4404) CFSTI: HC $3.00/MF $0.65 CSCL 03B

Presented is a compendium of the environmental data on trapped and untrapped radiation. It considers the calculated tissue dose rates received from these radiations and the induced secondary radiation behind various shield thicknesses. Energetic radiation, as used here, refers to particles with energies greater than about 0.5 MeV. The results should be of practical value for preliminary analysis of the radiation hazard to man during space flight. Author

N68-17020*# Volt Technical Corp., Washington, D. C.
ENERGY FLUX OF SOLAR PLASMA IN A SECTORIAL STRUCTURE OF THE INTERPLANETARY MAGNETIC FIELD [POTOK ENERGII SOLNECHNOY PLAZMY V SEKTORNOY STRUKTURE MEZHPLANETNOGO MAGNITNOGO POLYA]
I. V. Kovalevskiy 8 Feb. 1968 8 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 7, no. 6, 1967 p 978–981
(Contract NAS5-12487)
(NASA-CR-93064; ST-IMF-SP-10671) CFSTI: HC $3.00/MF $0.65 CSCL 03B

The three-hour values of the density of kinetic energy flux of the directed motion of the plasma q_1, and the flux density ofbthermal (q_2) and electromagnetic (q_3) energies for the positive and negative sectors of the interplanetary magnetic field, observed from December 1963 to February 1964 with the aid of AES IMP-1 are computed. The character is discussed of q_1, q_2, q_3 distribution in sectors and their relationship with solar plasma velocity. It is shown that $q_1 >> q_2 \approx q_3$ and that there is no particular difference between the sectors. Estimates are made of energy fluxes through sectors' cross-sections. Author

N68-17072*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
FIELD ALIGNED ELECTRON BURSTS AT HIGH LATITUDES OBSERVED BY OGO-4
R. A. Hoffman and D. S. Evans Dec. 1967 43 p refs
(NASA-TM-X-63093; X-611-67-592) CFSTI: HC $3.00/MF $0.65 CSCL 04A

In a series of passes in the northern high latitude region, short bursts of radiation were observed in the energy range 0.7 to 24 keV by detectors aboard the polar orbiting satellite OGO-4. Among these bursts were a number in which the pitch angle distributions at 2.3 keV displayed a maximum at small angles to the magnetic field lines. From the distributions and energy spectra it is argued that a possible source mechanism for these particles is electric fields parallel to the magnetic field lines at distances of several earth radii. The source particles would than be the ambient thermal plasma, with two markedly different temperature components, one at a few eV, from which the field aligned radiation originates, the other greater than an order of magnitude hotter, which produces the isotropic portion of the pitch angle distribution. Author

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N68-16108*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MARINER 4 PICTURES OF MARS
Robert B. Leighton, Bruce C. Murray, Robert P. Sharp, J. Denton Allen, and Richard K. Sloan 15 Dec. 1967 242 p refs
(Contract NAS7-100)
(NASA-CR-92682; UPL-TR-32-884) CFSTI: HC $3.00/MF $0.65 CSCL 03A

Procedures and described for correcting the original digital data for (1) the intensity and spectral transfer characteristics of the camera system, (2) the geometric distortions introduced by nonlinear effects in the TV-line scan, (3) the modulation transfer function of the camera, and (4) scattered light. The calibrated pictures are of very low contrast, intensity ranges (minimum to maximum) of from 15 to 30% being typical. The later pictures cover larger percentage ranges. Surface detail is only dimly visible in the pictures unless they are artificially enhanced in contrast. The luminous response characteristics of each picture element were determined using 45 uniformly exposed calibration pictures of known exposure value. The relative sensitivity was evaluated with respect to an approximate standard (nonlinear) function, using a quadratic least-squares fit. Possible causes of the hazy appearance of pictures of the limb and terminator regions were investigated both experimentally and analytically. Significant contributions both from instrumental glare and from scattering by the Martian atmosphere were found. Lower and upper limits on the haze and glare effects of from 20 to 30% were deduced. Author

N68-16174*# Chrysler Corp., New Orleans, La. Space Div.
AS-204/LM-1 L/V OPERATIONAL ALTERNATE MISSION TRAJECTORIES
A. Genter 31 Jul. 1967 198 p refs
(Contract NAS8-4016)
(NASA-CR-92804; TN-AP-67-262) CFSTI: HC $3.00/MF $0.65 CSCL 22C

The performance capability of the SA-204/LM-1 launch vehicle under the conditions imposed by the premature shutdown of a single S-IB engine was determined. The ground rules for the study were defined by the AS-204/LM-1 Launch Vehicle operational flight trajectory. Vehicle performance degradation due to single S-IB engine failure is graphically depicted. Under 3-sigma low flight conditions the vehicle has mission capability with an S-IB engine failure after 55.0 sec of flight. An engine failure of 36.1 sec of powered flight time would result in a 50% probability of mission success. An engine failure any time during flight would cause no problem from a controllability standpoint. Detailed trajectory data (yaw, roll, and pitch attitudes and deflections) are presented for S-IB stage single engine failures at flight times of 0, 36.1, and 55 secs. Tracking coverage for these three trajectories is also included. L.S.

N68-16221# Sandia Corp., Albuquerque, N. Mex.
EVALUATION OF SAMPLES FLOWN ON USAF ROCKET MISSION DURING LEONID SHOWER
Leo J. Klamerus Oct. 1967 36 p
(Contract AT(29-1)-789)
(SC-M-67-607) CFSTI: HC $3.00/MF $0.65

An evaluation is made of several sampling slides and microscopic grids used in an attempt to capture micrometeoritic particles during the great Leonid meteor shower of November 17, 1966. These samplers were aboard the payload of a USAF air-launch air-recovery rocket sent to 318,000 feet from White Sands Missile Range on that day. It is concluded that the majority of the particles observed on the collection surfaces are contamination artifacts. Nine specific recommendations are given to attempt to minimize this problem on future sampling missions. Author (NSA)

N68-16250*# American Science and Engineering, Inc., Cambridge, Mass.
A CONTINUATION OF A PROGRAM OF HIGH ANGULAR RESOLUTION STUDIES OF CELESTIAL X-RAY SOURCES Final Report, Jul. 6–Dec. 29, 1967
4 Jan. 1968 34 p refs
(Contract NASw-1634)
(NASA-CR-92697; ASE-1825) CFSTI: HC $3.00/MF $0.65 CSCL 03A

Design of the aspect camera, proportional counters, collimators, telemetry, and attitude control system; testing and calibration; and flight data results are reported in connection with high angular resolution studies of celestial X-ray sources. The payload, recovered two days following launch, exhibited little structural damage and all its electronic systems were operative. It is noted that either at liftoff or during powered flight, aerodynamic buffeting and/or heating caused the door of the payload to jam; and, because the door did not open until very late in the flight, no useful cosmic X-ray data were obtained. The flight, however, appears to have established the ability of the rise time discrimination system to reduce the cosmic background considerably. Details are presented of the reduction of cosmic background in an X-ray proportional counter through rise time discrimination. M.W.R.

N68-16255# Royal Inst. of Tech., Stockholm (Sweden). Plasma Physics Div.
GRAVITATIONAL ACCRETION OF SMALL MASSES ATTRACTED FROM LARGE DISTANCES AS A MECHANISM FOR PLANETARY ROTATION
R. T. Giuli Dec. 1967 12 p refs Sponsored by Swed. Natl. Sci. Res. Council Prepared jointly with Stockholm Obs
(Rept.-67-27) CFSTI: HC $3.00/MF $0.65

The trajectory integrations of the author have been extended to include bodies other than the earth. It is found that the two-dimensional model for gravitational accretion predicts long periods for bodies located beyond Mars' orbit, and shorter periods for bodies located with Mars' orbit. The quantity $C=P_{tot}/M_p^{2/3}$ is found to vary by no more than a factor of two among the planetary bodies. Author (ESRO)

N68-16264# Royal Inst. of Tech., Stockholm (Sweden). Electron and Plasma Physics Div.
A TENTATIVE NOTE ON THE POLYTROPE MODEL FOR THE SOLAR WIND AND THE INTERPLANETARY MAGNETIC FIELD
Erling Dahlberg 30 Oct. 1967 22 p refs
(Rept-67-21) CFSTI: HC $3.00/MF $0.65

A stellar wind model taking partial account of the influence of an interplanetary magnetic field is reviewed. The axisymmetric and stationary flow in infinitely conducting polytropic gas is studied in the equatorial plane under the assumptions that $B_\tau r^2 = \text{const.}$ and $\rho v_\tau r^2 = \text{const.}$ The type of flow consistent with this model and observational data should correspond to a solution that passes through two critical points as a result of the adjustment of two initial values, essentially mass flux and aximuthal magnetic field. The two critical points correspond to the points where the radial velocity becomes equal to either of the two propagation velocities for disturbances that are coplanar with the wave normal and the magnetic field. A computational scheme is suggested that should make it possible to find the solution that best fits the observational data. Author (ESRO)

N68-16271*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
POWER SERIES INVERSES OF THE UNIVERSAL FORM OF KEPLER'S EQUATION
R. H. Estes and E. R. Lancaster Jan. 1968 15 p refs
(NASA-TM-X-63090; X-643-68-40) CFSTI: HC $3.00/MF $0.65 CSCL 03C

Two power series inverses of the universal form of Kepler's equation are derived with simple recursion formulas for the coefficients. The first series is in powers of time, the second in powers of $a=1/a$, where a is the semimajor axis. The second series is particulary useful for nearly parabolic orbits, since Kepler's equation is easily solved when $a=0$, i.e., when the motion is parabolic. Author

N68-16304*# California Inst. of Tech., Pasadena.
INFRARED OBSERVATIONS OF POSSIBLE PROTOSTARS
E. E. Becklin and G. Neugbauer 1967 12 p refs Presented at HII Reg. Symp., Charlottesville, Va., Dec. 1967
(Grant NsG-426)
(NASA-CR-92724) CFSTI: HC $3.00/MF $0.65 CSCL 03A

Observational data are presented on several infrared objects in the HII regions and gaseous nebulae, which radiate 80% or more of their energy at wavelengths longer than 2μ. A possible protostar, the R. Monocerotis (R. Mon) located at the head of the variable nebula, is described as having a visual component classified as a T. Tauri star and radiating energy behond 2μ. Another object, similar to the R. Mon and located in the Orion Nebula, radiates energy at 5μ. The properties of the nebula obtained from observations at 20μ include flux, density, luminosity, and brightness temperature. B.S.D.

N68-16323*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE USE OF RESONANT SATELLITE ORBITS TO DETERMINE LONGITUDE VARIATIONS IN THE EARTH'S GRAVITY FIELD
C. A. Wagner Sep. 1966 99 p refs
(NASA-TM-X-63084; X-643-66-463) CFSTI: HC $3.00/MF $0.65 CSCL 22A

A satellite whose orbital rate is commensurate (or rational) with the earth's rotation rate will describe a constant ground track over a whole number of sidereal days. On such a satellite, the small orbit averaged along track force from certain longitude harmonics of gravity can build up over many commensurate (synodic) periods to produce appreciable changes in the semimajor axis of the orbit and longitude placement of the ground track. The libratory nature of these changes and the specific harmonics which can cause them for any resonance case are discussed with reference to a circular orbit. General formulas are presented for these librations, with typical errors determined by numerical integration. The specific

theory of the 24-hour, nearly circular orbit satellite is presented in detail with actual orbit data from three such satellites used to determine the resonant earth gravity sectorial harmonics through third order. It is shown that a number of subsynchronous circular resonant orbits offer similar promise in discriminating easily and uniquely other low and high order longitude harmonics; among them H_{32}, H_{43}, H_{54}, H_{55}, H_{76} and H_{98}. Author

N68-16380# Office of Aerospace Research, Los Angeles, Calif.
THE OV1—PROMOTER OF TIMELY SPACE RESEARCH
Clyde A. Northcott, Jr. *In its* Proc. of the OAR Res. Appl. Conf., 14 Mar. 1967 Mar. 1967 p 59–67 (See N68-16376 07-34)

The early stages of the Probes Program are reviewed, and the steps leading up to the development of the orbital vehicle, type one (OV1) are discussed. Since the OV1 was conceived of as a general purpose vehicle to support the requirements of space scientists, the electrical and mechanical interfaces were so configured that widely diversified payloads can be orbited with minimum change. Two sections house all support subsystems, while the third, and only nonstandard section, is reserved for experiments. An Atlas launch vehicle has been used. However, the OV1 propulsion module was also designed to be compatible with other launch vehicles without major redesign so that the program can react quickly to launches of opportunity. E.J.S.

N68-16395*# California Univ., Berkeley. Space Sciences Lab.
THE INTERPLANETARY MAGNETIC FIELD; SOLAR ORIGIN AND TERRESTRIAL EFFECTS
John M. Wilcox 8 Jan. 1968 138 p refs *Its* No. 9, Issue No. 2
(Grants NsG-243; NGR-05-003-230; Contract Nonr-3656(26))
(NASA-CR-93005) CFSTI: HC $3.00/MF $0.65 CSCL 03B

Many observations related to the large-scale structure of the interplanetary magnetic field, its solar origin and terrestrial effects are discussed. During the period observed, the interplanetary field was dominated by a sector structure corotating with the sun in which the field is predominantly away from the sun (on the average in the Archimedes spiral direction) for several days (as observed near the earth), and then toward the sun for several days, etc. The average sector appears to be a coherent entity with internal structure such that its preceding portion is more active than its following portion. Cosmic rays corotate with the interplanetary field, and there are differential flows associated with the sector pattern. Profound effects on geomagnetic activity and the radiation belts are produced as the sector pattern rotates past the earth. The solar origin of the sector pattern is discussed. The solar source may be associated with the large-scale weak background photospheric fields observed with the solar magnetograph. It is suggested that there may be a rather continual relation between this solar structure and terrestrial responses, of which the recurring M-Region geomagnetic storms are just the most prominent example. Author

N68-16424*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
A FOURIER TRANSFORM TECHNIQUE FOR THE PREDICTION OF TORSIONAL TRANSIENTS FOR A SPACECRAFT FROM FLIGHT DATA OF ANOTHER SPACECRAFT USING THE SAME BOOSTER
M. R. Trubert 15 Oct. 1967 24 p refs
(Contract NAS7-100)
(NASA-CR-92994; JPL-TM-33-350) CFSTI: HC $3.00/MF $0.65 CSCL 22A

A frequency-domain solution for determining the torsional acceleration transient occurring at booster engine cutoff for the *Surveyor* spacecraft, using the *Ranger* data, is presented. First, the Fourier transform of the transient acceleration, which occurred at the base of the spacecraft during the *Ranger* flights, is computed. The next step is the computation of the transfer function of the *Atlas/Centaur/Surveyor* vehicle, also using the normal modes of the structure. Then the Fourier transform of the transient acceleration at the *Surveyor* field joint is determined, assuming that the same torque is present at the gimbal blocks of the *Atlas* engine for both spacecraft, since the same booster is used. Finally, the time history of the *Surveyor* field joint acceleration is computed by inverse Fourier transformation. A digital computer program has been written which computes direct and inverse Fourier transforms, and also operates on the transfer functions of the structures. The results are compared, using *Ranger VI, VII, VIII* and *IX* data. Author

N68-16470*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
JPL LUNAR EPHEMERIS NUMBER 4
J. Derral Mulholland and Neil Block 1 Aug. 1967 50 p refs
(Contract NAS7-100)
(NASA-CR-92993; JPL-TM-33-346) CFSTI: HC $3.00/MF $0.65 CSCL 03A

This memorandum provides a detailed discussion of the revised lunar ephemeris contained in Development Ephemeris 19 (DE 19), the second version of the JPL Ephemeris System to be issued for general distribution. The revision is based on improvements in the Lunar Theory, improvements in computational processes, and improvements in the fundamental astronomical constants. This latter category represents the practical application of scientific data provided by the space research programs. The new version of the lunar ephemeris is compatible with the system of astronomical constants currently adopted by the International Astronomical Union and consists of a corrected form of the Improved Brown Lunar Theory. Author

N68-16490# California Inst. of Tech., Pasadena. Owens Valley Radio Observatory.
RADIO MEASUREMENTS OF PLANETARY NEBULAE
A. R. Thompson (Stanford Univ.) [1967] 14 p refs Submitted for publication
(Contract N00014-67-A-0094-0008)
(AD-663168)

Sixty-eight planetary nebulae were investigated in a series of observations at 10 cm wavelength using the two 90-ft. diameter antennas of the Owens Valley Radio Observatory. Of these, fifty-two were found to have flux densities greater than a minimum detectable level of approximately 10 to the -27th power W/Hz m squared. To indicate cases of possible confusion in the radio observations, the measured radio position of each nebula was compared with an accurate optical position. For a number of the stronger nebulae angular widths in the east-west direction and flux densities in H beta were calculated. A comparison with optical data shows values of the H beta absorption delta log F sub H Beta, ranging from zero to approximately 2.0 for NGC 6537 and NGC 6369. A small number of nebulae show prominently the effects of self-absorption in their radio spectra. Two nebulae, NGC 6369 and NGC 6857, show absorption which is probably attributable to hydrogen clouds within the galaxy. No definite evidence of absorption at frequencies near the radial velocities of the nebulae was found, and an upper limit on the mass of neutral hydrogen in two nebulae is briefly discussed. TAB

N68-16537*# Volt Technical Corp., Washington, D. C.
CONSIDERATIONS ON THE RETURN TRAJECTORIES FROM THE MOON TO THE EARTH [O TRAYEKTORIAKH VOZVRASHCHENIYA OT LUNY K ZEMLE]

V. A. Yegorov 8 Feb. 1968 13 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 5, no. 4, 1967 p 483–493
(Contract NAS5-12487)
(NASA-CR-92716; ST-CM-AD-10673) CFSTI: HC $3.00/MF $0.65 CSCL 22A

Considered are trajectories beginning near the moon, emerging from its sphere of action on the first revolution, and approaching the earth during the first orbit around it. The axial trajectories of the trajectory beams pass through the center of the earth. They begin either on the lunar surface or on orbits of artificial satellites of the moon. Possible types of return trajectories are indicated and their evolution is ascertained with the change of initial velocity modulus. The influence of initial data scattering is approximately analyzed. Author

N68-16557*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SAMPLING OF PLANETARY SURFACE SOLIDS FOR UNMANNED IN SITU GEOLOGICAL AND BIOLOGICAL ANALYSIS: STRATEGY, PRINCIPLES, AND INSTRUMENT REQUIREMENTS
Douglas B. Nash 15 Nov. 1967 42 p refs
(Contract NAS7-100)
(NASA-CR-92749; JPL-TR-32-1225) CFSTI: HC $3.00/MF $0.65 CSCL 22A

The scientific principles, objectives, and requirements for unmanned sampling of planetary surface rocks for *in situ* analyses are reviewed. Sampling is a priority objective of early surface reconnaissance planetary missions, and the development of suitable sample-acquisition devices is critical to the progress of planetary exploration. The sampling requirements for analytical instruments to be used for measurements of high priority are reviewed and shown to reduce to one set of standard parameters suitable for any combination of instruments in a payload. The sampling requirements for both geological and biological *in situ* analyses of soils and rocks are discussed and shown to be essentially identical; therefore, engineering development studies of sampling devices for both geoanalysis and bioanalysis experiments should be conducted not separately, but as an integrated study for which the term *geosampling* is an adequate description. Author

N68-16585*# Vanderbilt Univ., Nashville, Tenn. Dept. of Mathematics.
APPLICATIONS OF HAMILTON–JACOBI THEORY TO TRAJECTORY OPTIMIZATION
Surinder Kumar Lakhanpal (M.S. Thesis) Jan. 1968 37 p refs
(Grant NGR-43-002-015)
(NASA-CR-93067) CFSTI: HC $3.00/MF $0.65 CSCL 22C

The basic theory is presented and necessary conditions of calculus of variations are stated for the Mayer control problem, followed by the development of Hamilton–Jacobi theory for such problems. The procedure for utilizing the decomposition of the Hamiltonian into base and perturbing Hamiltonians is explained. A simple Mayer control problem of the Zermelo navigational problem type is solved to illustrate the theory, and two methods of splitting the Hamiltonian are compared. The main problem, of minimizing the fuel of a low-thrust rocket rendezvousing a satellite in a circular orbit, is treated. The terms in the Hamiltonian involving thrust of the rocket engine are taken as the perturbing Hamiltonian. The partial differential equation for the base Hamiltonian is solved by a combination of separation of variables and Lagrange's method for linear equations. The procedure for completion of the problem is indicated but not carried out. Transversality conditions are used to obtain enough conditions to determine the constants of integration. Author

N68-16598*# Michigan Univ., Ann Arbor. Dept. of Meteorology and Oceanography.
THE CALCULATION OF LONG-WAVE RADIATIVE TRANSFER IN PLANETARY ATMOSPHERES
J. Roland Drayson (Ph.D. Thesis) and Edward S. Epstein Nov. 1967 122 p refs
(Contracts NASr-54(03); Cwb-11376; Cwb-11106; Grant NSF GP-4385)
(NASA-CR-92998; Rept.-07584-1-T) CFSTI: HC $3.00/MF $0.65 CSCL 03B

A method is developed for calculating long-wave radiative transfer in a plane parallel atmosphere. Modern computing techniques are used to avoid approximations commonly used in existing methods. Two application involving the 15μ bands of CO_2 are given, the first to the earth's mesosphere and lower thermosphere, taking vibrational relaxation into account and the second to the Martian atmosphere, for use in a simple atmospheric circulation model. Atmospheric radiative fluxes and flux divergences are obtained by direct integration with respect to frequency across the absorption bands. The atmosphere is divided into horizontal layers which may be made arbitrarily thin. The direct integration method allows the Curtis–Godson approximation to be applied over successive thin layers, rather than thick atmospheric layers. Author

N68-16619# Naval Research Lab., Washington, D. C.
CALCULATIONS OF STELLAR STRUCTURE
Carl A. Rouse 18 Sep. 1967 29 p refs
(NRL-6580; AD-663110)

Calculations of the authors solar model, reported at the New York APS meeting, Jan. 1965, were continued at the Naval Research Laboratory as part of a research program undertaken as an E. O. Hulburt Research Appointee. Of particular significance is that due to the increased mathematical and physical accuracies introduced at NRL, the resulting photospheric densities lead to mean atomic volumes in excellent agreement with those needed to explain the drop in intensity of photospheric hydrogen lines through screening. The solar model itself is the first known continuous calculation -- from the center through the photosphere -- of the suns mass, radius, and luminosity. The resulting model, incidentally, yields values of electron pressure and temperature in the photosphere in good agreement with the currently accepted photospheric values. TAB

N68-16655# California Univ., Livermore. Lawrence Radiation Lab.
A NUMERICAL INVESTIGATION OF THE ENERGY BALANCE OF THE PLANET MARS
Monty D. Coffin (Ph.D. Thesis) 16 Aug. 1967 62 p refs
(UCRL-50309; UC-34) CFSTI: HC $3.00/MF $0.65

An effort was made to simulate the gross features of the energy balance of the planet Mars. A six-level atmospheric model was used. Energy-transfer processes in the atmosphere are coupled to heat conduction and energy storage in the surface layers of the planet. A two-dimensional model is used so that calculations can be made throughout annual orbital periods. Simplified methods, appropriate to the Martian atmosphere, are developed for treating solar radiation absorption, longwave radiation transport, and vertical convective transport. The use of CO_2 as the only active volatile in the Martian atmosphere give results which appear to be consistent with observations. In particular, the formation and dissipation of the polar caps is in good agreement with observations. The surface energy balance is found to be relatively independent of atmospheric effects including the horizontal transport of energy. There are indications that CO_2 in the upper atmospheric levels is in a saturated equilibrium state. Author (NSA)

N68-16682# Weapons Research Establishment, Salisbury (Australia).

A COMPUTER PROGRAM FOR PREDICTING THE APPARENT POSITION OF THE SUN

S. Parkhill Jul. 1967 52 p refs

(WRE-TN-SAD-177) CFSTI: HC $3.00/MF $0.65

A computer program has been written to predict the apparent position of the sun at various times throughout the year for an observer at a given position on the surface of the earth. The basic formulae used are derived, and the effects of terrain obscurations on the times of sunrise and sunset are included. Detailed instructions are given on the use of the program on the IBM 7090. Author

N68-16687# Weapons Research Establishment, Salisbury (Australia).

INTERFEROMETER OBSERVATIONS ON QUASAR 3C 273B

J. S. Gubbay and D. S. Robertson Jul. 1967 9 p refs

(WRE-TN-APD-9) CFSTI: HC $3.00/MF $0.65

In June 1967 two NASA Deep Space Stations in Australia, DSS 41 at Island Lagoon and DSS 42 at Tidbinbilla were operated as a post detection interferometer to observe the angular dimensions of quasar 3C 273B. The results show that the source is not resolved at an effective baseline of 9 million wavelengths. Author

N68-16732*# Stanford Univ., Calif. Radioscience Lab.

THE ATMOSPHERE OF MARS ANALYZED BY INTEGRAL INVERSION OF THE MARINER 6 OCCULTATION DATA Final Report

Gunnar Fjeldbo and Von R. Eshleman Nov. 1967 61 p refs

(Grant NGR-05-020-065)

(NASA-CR-92718; SEL-67-109) CFSTI: HC $3.00/MF $0.65 CSCL 03B

The aim of this paper is to present results of a detailed analysis of the Mariner IV radio occultation data, using the data as directly as possible with a minimum number of assumptions and interpretations. Integral inversion of the basic measurements is used to obtain height profiles of refractivity over the immersion and emersion points on Mars. For the upper atmosphere this yields directly the ionospheric profile, from which a profile representing plasma temperature divided by mean molecular mass is derived assuming either diffusive or photoionization equilibrium conditions. Molecular number density, temperature, and pressure profiles for the lower atmosphere are derived for two constituent models assuming only mixed, non-polar molecules in hydrostatic equilibrium. It is believed that rather high precision has been obtained for conditions at the immersion point, but that the emersion results are less precise due to a change in the mode of operation of the radio system. Author

N68-16750*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

PHOTOMETRY OF AN IRON ARTIFICIAL METEOR REENTERING AT 11 KILOMETERS PER SECOND

J. B. Robertson and Wendell G. Ayers Washington Feb. 1968 27 p refs

(NASA-TN-D-4312) CFSTI: HC $3.00/MF $0.65 CSCL 22A

A man-made meteor was successfully produced in March of 1966 by reentering into the atmosphere a 5.7-gram steel pellet at 10.85 km/sec with a six-stage, solid-fuel Trailblazer II vehicle, the last stage of which was an explosive accelerator. The meteor was photographed with a system of cameras and spectrographs. The luminous power of the meteor as a function of time was determined from the photographs with stars for calibration. The velocity and deceleration of the meteor were determined from photographs taken by cameras with chopping shutters. The luminous efficiency of the meteor was calculated from the luminous power and velocity data. The panchromatic luminous efficiency was $(4.0 \pm 0.8) \times 10^{-3}$ and the blue sensitive luminous efficiency was $(2.1 \pm 0.4) \times 10^{-3}$. A spectrogram of the meteor on blue sensitive film showed that the radiation produced by the meteor in the spectral region from 3800 Å to 5000 Å was predominately line radiation from neutral iron. A filter photograph indicated considerable radiation in the spectral region from 4900 Å to 6500 Å. A large portion of this radiation may have been produced by iron oxide. Author

N68-16793*# Chrysler Corp., New Orleans, La. Space Div.

AS-206 S-4B RESTART ALTERNATE MISSION L/V OPERATIONAL FLIGHT TRAJECTORY, PART 3

T. B. Pederson and B. B. Barrett 15 Sep. 1967 185 p refs

(Contract NAS8-4016)

(NASA-CR-92805; TN-AP-67-264; Pt. 3) CFSTI: HC $3.00/MF $0.65 CSCL 22C

Trajectory data are tabulated for all phases of the AS-206 restart alternate mission for which the Saturn IB launch vehicle has a functional requirement, and a summary of launch vehicle characteristics and flight environment is presented. Predicted S-IB/S-IVB separation S-IVB state first burn (guidance cutoff signal), and S-IVB second burn (depletion cutoff signal) end conditions are included. Nominal weight in orbit is predicted to be 67,675 lb, of which 31,167 lb is useable S-IVB stage propellant that is depleted 74,962 sec after the S-IVB stage restart signal. The S-IVB stage restart occurs after an orbital coast phase of approximately two revolutions or 10,875 sec; and the S-IVB stage flight performance reserve for the mission is about 1,200 lb, which means predicted useable propellant at orbit insertion may deviate by this weight. An H-1 engine out performance evaluation was conducted. Vehicle data, subsystem characteristics, and guidance and control modes for the mission are included. M.W.R.

N68-16809# Martin Co., Denver, Colo.

ANALYSIS AND COMPARISON OF SPACECRAFT RESOURCES FORECASTING TECHNIQUES FOR UNMANNED MISSIONS

S. L. Rosing and W. J. Bursnall 27 Oct. 1967 16 p refs Presented at Ann. Meeting of the AIAA, Anaheim, Calif., 23–27 Oct. 1967

Future space programs face tougher evaluation by the Executive Branch and Congress in light of priority shifts and lower confidence in cost forecasting precision. Existing techniques are reviewed with emphasis on proposed program resource forecasting, as contrasted to expenditure estimates for a program underway. Selected techniques are compared and evaluated against two examples—Mariner C and Voyager. These techniques generally employ linear regression analyses of existing and past programs. The paper presents the impact of new technology not specifically accounted for in these techniques, such as increasing complexity of experiments, long-life reliability and sterilization, on the forecasting precision. Present models have a reasonable rms error in forecasting past and present programs, but individual programs exhibit large deviations that suggest the sensitivity of cost to new technology. Author

N68-16871*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

PERTURBATIONS OF THE INTERPLANETARY MAGNETIC FIELD BY THE LUNAR WAKE

N. F. Ness, K. W. Behannon, H. E. Taylor, and Y. C. Whang Jan. 1968 49 p refs Submitted for publication *Its* Preprint

(NASA-TM-X-63094; X-612-68-12) CFSTI: HC $3.00/MF $0.65 CSCL 03B

Detailed measurements of the interplanetary magnetic field in the vicinity of the moon were performed on the Explorer 35

selenocentric spacecraft. The interplanetary magnetic field appears to be convected through the lunar body without a large scale distortion of its direction or magnitude. Perturbations as much as 30% of the average magnitude are noted in the solar plasma umbra and penumbra. As the satellite passes through the leeward flow an alternating pattern of magnitude increases and decreases is observed in the penumbra while generally only an increase is observed in the umbra. Using a theoretical model of plasma flow, a first order solution of the perturbed interplanetary magnetic field is compared with observations. It is concluded that the perturbations can be partially explained on the basis of the magnetization, gradient and curvature currents induced in the disturbed solar plasma flow. Author

N68-16955# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.

STUDIES IN SPACE RADIO PHYSICS

S. H. Gross *In its* Microwave Res. Inst. Programs Nov. 1967 p 112–115 (See N68-16927 07-10)

(Grant NSF GU-1557)

The initial program for ionospheric and solar radio physics projects experimental and theoretical studies in radar technology, total electron content measurements, ionospheric absorption measurements, techniques of interpretation, wave theoretical analyses, etc. Major points of interest are the nature and physics of ionospheric irregularities and the extension of radio astronomical observations to wavelengths below 1 mm. Preliminary design data for a 3 mm radio telescope are also considered. G.G.

N68-17021*# Volt Technical Corp., Washington, D. C.

METHOD OF DETERMINATION OF ION TEMPERATURE BY THE VARIATIONS OF SATELLITE INDUCED ION TRAP CURRENTS AND ESTIMATE OF THE UPPER LIMIT OF ION TEMPERATURE AT ALTITUDES OF 10,000 KILOMETERS AND HIGHER ACCORDING TO DATA OF AES "ELEKTRON-2" [SPOSOB OPREDELENIYA IONNOY TEMPERATURY PO IZMENENIYAM TOKA IONNOY LOUUSHKI, VYZVANNYM VRASHCHENIYEM SPUTNIKA, I OTSENKA VERKHNEGO PREDELA IONNOY TEMPERATUTY NA VYSOTAKH 10,000 KM PO DANNYK "ELEKTRONA-2"]

K. I. Gringauz, V. V. Bezrukikh, and T. K. Breus 21 Feb. 1968 9 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 5, no. 2, 1967 p 245–250

(Contract NAS5-12487)

(NASA-CR-93006; ST-AI-PF-10674) CFSTI: HC $3.00/MF $0.65 CSCL 03B

It is shown that measurements of collector current variations of an ion trap with zero potential at outer grid, installed aboard a spinning spacecraft flying within the ionosphere, may be utilized for the determination of ion temperature T_i. The estimates of the upper limit of T_i made after the data of the ion trap installed aboard AES Elektron-2 have shown that in the altitude range 4000 km to 8000 km the temperature of ions did not exceed 10,000°K. Author

N68-17031# Smithsonian Astrophysical Observatory, Cambridge, Mass.

VARIABLE STARS—THREE INVESTIGATIONS

S. A. Zhevakin and D. A. Frank-Kamenetskii 20 Nov. 1967 51 p refs Transl. into ENGLISH from Various Russian Articles *Its* Astron. Papers Transl. from the Russ. no. 11

CONTENTS:

1. A DISCRETE MODEL OF A STAR (OSCILLATION AND EXPLOSION), 1 S. A. Zhevakin p 3–26 refs (See N68-17032 07-30)

2. PULSATIONS NEAR STELLAR SURFACES D. A. Frank-Kamenetskii p 23–33 refs (See N68-17033 07-30)

3. ON THE AUTO-OSCILLATIONS OF ONE CEPHEID MODEL S. A. Zhevakin p 35–44 refs (See N68-17034 07-30)

N68-17032# Smithsonian Astrophysical Observatory, Cambridge, Mass.

A DISCRETE MODEL OF A STAR (OSCILLATION AND EXPLOSION), 1

S. A. Zhevakin *In its* Variable Stars 20 Nov. 1967 p 3–26 refs Transl. into ENGLISH from Astron. Zh. (USSR), v. 29, 1959 p 37–48 (See N68-17031 07-30)

To permit a comparatively simple analysis of such nonstationary processes in stars as explosions and oscillations, a nonconservative discrete stellar model was constructed to adequately represent the vibrating state. The discrete model with one degree of freedom, corresponding to a star with radiative energy transfer, is mathematically described. To assess the degree to which this model with a stable center corresponds to a real star, a comparison is made with other models recognized as representing the interior structure of a star. The cases examined lead to the conclusion that even the discrete model of one degree of freedom gives results close to those of a more complex model, such as a continuous system. As an example of the usefulness of the discrete model, a model of one degree of freedom with thermonuclear energy production is examined. It is shown that the nuclear reaction mechanism maintaining the vibration does not lead to auto-oscillations of admissible amplitude. M.G.J.

N68-17033# Smithsonian Astrophysical Observatory, Cambridge, Mass.

PULSATIONS NEAR STELLAR SURFACES

D. A. Frank-Kamenetskii *In its* Variable Stars 20 Nov. 1967 p 28–33 refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 99, no. 1, 1954 p 41–43 (See N68-17031 07-30)

An approximate expression for a nonadiabatic oscillating process is derived without resorting to linearizing the equations. The star is broken into a central zone where the pulsations can be considered as adiabatic, and a peripheral zone where curvature and emission of energy can be neglected. It is assumed that the thickness of the peripheral zone is large compared with the path of radiation. From the formulas given, deductions can be made on the connection between the amplitude and period of vibration, and between the amplitude and asymmetry. M.G.J.

N68-17034# Smithsonian Astrophysical Observatory, Cambridge, Mass.

ON THE AUTO-OSCILLATIONS OF ONE CEPHEID MODEL

S. A. Zhevakin *In its* Variable Stars 20 Nov. 1967 p 35–44 refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 58, no. 3, 1947 p 385–387 (See N68-17031 07-30)

It is shown for the case of a discrete stellar model that the hypothesis of thermonuclear production of stellar energy leads to the establishment of stellar oscillations whose amplitude is independent of the initial conditions. The possibility of explaining the existence of auto-oscillation by means of the pulsation theory and the hypothesis of thermonuclear production of stellar energy provides an important indirect argument for the use of this hypothesis. The argument is especially essential in regard to red giants, for which the thermonuclear character of the emitted energy is in dispute. Author

N68-17074*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
A COMPREHENSIVE STUDY OF THE CHARACTERISTICS OF METEOR ECHOES, 1
Gerald S. Hawkins and John C. Brown 30 Oct. 1967 36 p refs *Its* Special Rept.-254
(Contracts NSR-09-015-033; NAS9-4873; AF 19(628)-3248)
(NASA-CR-92667) CFSTI: HC $3.00/MF $0.65 CSCL 03B

A system of classification of the shapes of meteor echoes is established, and a recording on punch cards of this classification with data on the meteors' physical properties is described. A simple velocity-computation method is described, and a number of statistical relations of shapes and physical properties are computed. The survey covers about 1000 meteors with a comprehensive study of all echo types. It shows some characteristics of the stations and selection effects in the established reduction program. Author

N68-17085*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ENVIRONMENT OF MARS: AN INTERPRETATION OF ATMOSPHERIC AND SURFACE CHARACTERISTICS
Otha H. Vaughan, Jr. and D. K. Weidner 1 Nov. 1967 137 p refs Supersedes NASA-TM-X-53167; NASA-TM-X-53484 (NASA-TM-X-53668; NASA-TM-X-53167; NASA-TM-X-53484) CFSTI: HC $3.00/MF $0.65 CSCL 03B

A realistic definition of the Mars environment that is based on observational data and theoretical considerations is presented. Many atmospheric and surface models have been postulated for the much-observed planet; however, most of these models are based on specific types of earth-based observational data (thermal, spectographic, photographic, radar) or purely theoretical considerations of both. This report has made use of these types of data, along with data from Mariner IV to develop atmospheric and surface models which are more consistent with all presently available data. The editors believe that these models are the most realistic for use as design criteria guidelines at the present time. Author

N68-17125# Plesset (E. H.) Associates, Inc., Santa Monica, Calif.
THE EFFECTS OF WEATHER ON THE OPTICAL DETECTION OF DEEP SPACE NUCLEAR BURSTS, PART 1
W. Green and R. Frank [1967] 8 p Presented at Ann. Meeting of the Opt. Soc. of Am., Detroit, Oct. 1967
(C-83-58103 Pt-1; CONF-671022-1)

A method of computing the direct and scattered light flux received by a ground-based detector from a fluorescent light source in the earth's upper atmosphere is discussed. This light source is assumed to be caused by the arrival of X rays that originate from a deep-space nuclear detonation. The main purpose of the study was to determine the effect of the scattered light flux on the time history of the signal received by the detector. Author (NSA)

N68-17147# Royal Aircraft Establishment, Farnborough (England).
ON THE SOLUTION OF THE SHADOW EQUATION FOR SMALL ECCENTRICITIES [O RESHENII URAVNENIYA TENI PRI MALYKH EKSTSENTRISITETAKH]
Yu. V. Batrakov Oct. 1967 11 p refs Transl. into ENGLISH from Byul. Inst. Teor. Astron. (USSR), v. 11, no. 1 (124), 1967 p 14–17
(RAE-LIB-TRANS-1253)

The equation for intersections of a satellite orbit with the earth's shadow (the shadow equation) is written in a form suitable for iterative solution when the orbital eccentricity is small. Examples of the solution of the shadow equation are given. Author

N68-17169*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPLORING IN AEROSPACE ROCKETRY. AEROSPACE ENVIRONMENT
John C. Evvard Washington 1968 29 p refs Presented to Lewis Aerospace Explorers, Cleveland, 1966–1967
(NASA-TM-X-52388) CFSTI: HC $3.00/MF $0.65 CSCL 22A

An introduction to the solar system is presented, emphasizing solar activity and the earth's environment. Atmospheric composition and the geomagnetic field are described, along with the type of data obtainable with earth satellites and also by observation from manned spacecraft. Details are given of the satellite's orbit and communication with ground stations, and on the composition of the Van Allen belts. Dangers to spacecraft from solar flares and meteoroids are also described. N.E.N.

N68-17180*# Chrysler Corp., New Orleans, La. Space Div.
AS-207 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY DISPERSION ANALYSIS
T. B. Pederson 1 Jul. 1967 75 p refs
(Contract NAS8-4016)
(NASA-CR-92803; TN-AP-67-229) CFSTI: HC $3.00/MF $0.65 CSCL 22C

In order to establish realistic deviation limits for the AS-207 launch vehicle operational flight trajectory, a dispersion analysis was conducted and is presented. The error sources considered for the dispersion analysis are those associated with predictions of vehicle characteristics, vehicle systems performance, and flight environment. The nominal vehicle and trajectory, error sources, the analytical procedures used, and the results are discussed. Author

N68-17188# Lincoln Lab., Mass. Inst. of Tech., Lexington.
A TRAJECTORY ANALYSIS PROGRAM (TRAP)
Anthony Bertolini 29 Sep. 1967 92 p refs
(Contract AF 19(628)-5167; ARPA Order 498)
(TN-1967-48; ESD-TR-67-508; AD-663227)

A FORTRAN IV program package has been written for the generation, analysis, and estimation of re-entry trajectories. The following functions may be performed by the program: (1) Generation of simulated noiseless trajectory data by integrating the differential equations of motion, using a predictor-corrector method. (2) Error analyses on trajectories generated by the program, in which the effects of hypothetical errors in the initial state and subsequent measurements may be studied. (3) Estimation of state vector quantities, using a recursive Kalmanfilter scheme, from (a) Simulated noisy data generated by the program. (b) Noisy radar measurements, supplied externally to the program. Author (TAB)

N68-17215*# North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.
GUIDANCE, FLIGHT MECHANICS AND TRAJECTORY OPTIMIZATION. VOLUME 2: GUIDANCE EQUATIONS FOR ORBITAL OPERATIONS
G. E. Townsend, D. R. Grier, and A. L. Blackford Washington NASA Feb. 1968 121 p refs
(Contract NAS8-11495)
(NASA-CR-1010; SID-66-1678-3; V. 11) CFSTI: HC $3.00/MF $0.65 CSCL 22C

This monograph develops the mathematical formulations of the maneuver in orbit problem and presents solutions for analyzing space missions and the associated guidance process. This is accomplished by isolating those factors which affect the motion of a vehicle and by defining the optimum sequence of events

required to produce the desired motion. The maneuvers are considered in two general classes. The first class, referred to as gross maneuvers, contains all of those corrective strategies in which the individual corrections are of such mangitude as to require that the nonlinear equations describing the maneuver be solved explicitly to obtain the required accuracy. The second class of maneuvers contains all of the corrective strategies which are sufficiently small to allow the nonlinear equations describing them to be expanded in a first order series in the neighborhood of a pre-selected nominal trajectory without adversely affecting the accuracy of the analysis. This class of maneuvers, referred to as differential corrections or midcourse corrections, is treated by progressing from a simplified guidance process to optimal control as measured by several loss functions. Examples of application are also given. K.W.

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N68-16114*# American Science and Engineering, Inc., Cambridge, Mass.

AN X-RAY EXPLORER TO SURVEY GALACTIC AND EXTRAGALACTIC SOURCES: PROGRAM DEFINITION PHASE Final Report

15 Jun. 1967 60 p

(Contract NASw-1506)

(NASA-CR-92699; ASE-1640-A) CFSTI: HC $3.00/MF $0.65 CSCL 22B

The scientific objectives and constraints which they impose upon the design of the instrument systems are reevaluated in order to restrict the total weight for the unit to 140 lbs. This will be done by reducing the weight of the X-ray detectors. The revised requirements for the electronic, mechanical, and thermal design are presented along with the results of the reevaluation to reduce weight. Details are given on how the reduction in weight, while reducing sensitivity and reliability, will still permit achievement of essentially all the scientific objectives. It is determined that the weight reduction will decrease the probability of a long lifetime in orbit by the elimination of two of the four counter banks and associated electronics. The ability to cross-switch detectors and electronics in the remaining channels was incorporated to offset this decrease. B.S.D.

N68-16120# White Sands Missile Range, N. Mex. Atmospheric Sciences Lab.

LAUNCHER SETTINGS VERSUS JACK SETTINGS FOR AEROBEE-150 LAUNCHERS—LAUNCH COMPLEX 35 WHITE SANDS MISSILE RANGE, NEW MEXICO

Gordon L. Dunaway and Mary Ann B. Seagraves Aug. 1967 307 p

(ECOM-5152, Sup. A; AD-661082)

A table of launcher setting versus jack settings for Aerobee-150 launchers is presented for launch complex 35 White Sands Missile Range, New Mexico. TAB

N68-16133*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

DATA PROCESSING PLAN FOR ECCENTRIC ORBITING GEOPHYSICAL OBSERVATORY (OGO-E)

Henry G. Linder Jan. 1968 161 p *Its* Preprint

(NASA-TM-X-63095; X-565-68-19) CSCL 22B

Details are given on the data processing systems and operations of the OGO-E with a payload of 25 experiments designed for the study of charged particles, measurement of magnetic fields, and observation of various ionospheric and radioastronomical phenomena. A brief description of the scientific objectives and detection devices of each experiment is also included. Consideration is given to the spacecraft telecommunications system, the PCM telemetry, and the main frame words in the PCM telemetry. The operation of the ground stations is discussed, and a list of the data acquisition stations is presented. The data processing systems are described in terms of performing the three major tasks of launch support, quick-look, and chronological production processing. The responsibilities of the production control and quality control groups are delineated. B.S.D.

N68-16193*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

GODDARD 66: A YEAR IN REVIEW AT GODDARD SPACE FLIGHT CENTER

[1966] 146 p refs

(NASA-TM-X-60838) CFSTI: HC $3.00/MF $0.65 CSCL 22B

A chronological account of events pertaining to satellite, scientific sounding rocket, and spacecraft missions in which Goddard Space Flight Center was involved, is presented. Goals of the Center are reviewed. Tracking, command, control, and data acquisition facilities are described. The Space Science and Applications Programs are discussed. Highlights of various space satellite programs are reviewed; and project summary data are given. L.S.

N68-16194*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.

APOLLO/SATURN 1B FLIGHT SAFETY PLAN VEHICLE AS-204/LM1

15 Dec. 1967 16 p

(NASA-TM-X-60841; K-IB-02.13/4) CFSTI: HC $3.00/MF $0.65 CSCL 22D

The plan outlines flight safety responsibilities for the Air Force Eastern Test Range and Kennedy Space Center and presents flight safety requirements, restrictions, and instrumentation necessary for each Apollo/Saturn IB launch. K.W.

N68-16204*# National Aeronautics and Space Administration, Washington, D. C.

SOLAR EXPLORER B

25 Feb. 1968 12 p

(NASA News Release-68-36) Available from the Scientific and Technical Information Division CSCL 22B

Mission goals and spacecraft configuration details are reported for the planned launching of Solar Explorer B (Explorer 37, when orbited). Highlighted is the satellite's digital data storage system, capable of recording data from three of the crafts solar radiation detectors over a 14-hour period by readout on ground command. Other solar radiation data are transmitted in real-time over an analog telemetry system. Background information is included on solar radiation phenomena, the significance of space research efforts, radiation measurement techniques, and the use of sounding rockets for collecting solar radiation data. A description of the Scout Launch Vehicle is given. E.C.

N68-16225* Boeing Co., Seattle, Wash.
LUNAR ORBITER 5: APPENDICES
12 Dec. 1967 402 p
(Contract NAS1-3800)
(NASA-CR-86530; D2-100755-6) CFSTI: $3.00 CSCL 22B

Cross reference data for lunar photographs taken of the lunar surface from the Lunar Orbiter V are presented. The photographs appear in the form of 1) 35 mm film, and 2) hand reassembled prints. Data tabulated include photo site, spacecraft exposure number, photo sequence number, recording Deep Space Instrumentation Facility site, readout sequence, GRE roll number, KI number, Framlet number, and other pertinent data. L.S.

N68-16240*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EXPERIMENTAL STABILITY AND CONTROL RESULTS AT MACH 19 OF AN ENTRY VEHICLE DESIGNED FOR AN INTERMEDIATE LIFT–DRAG RATIO
Patrick J. Johnston and Robert D. Witcofski Washington Feb. 1968 52 p refs
(NASA-TN-D-4337) CFSTI: HC $3.00/MF $0.65 CSCL 22A

An exploratory investigation of the longitudinal, lateral, and directional stability and control characteristics of a lifting entry vehicle was conducted at a Mach number of 19 and a Reynolds number, based on length, of 3.05×10^6. At these conditions the boundary layer is believed to be laminar over the model. The configuration, which was characterized by a large-volume fuselage, was designed to achieve a trimmed maximum lift-drag ratio of 2.0. Realistic centers of gravity dictated by packaging studies were employed to evaluate the stability results. The effects on stability and performance of wing planform shape and size, ventral body fins, wing-tip fins, and body camber were examined. The final configuration, which included a shoulder-height wing with tip fins, achieved a trimmed maximum lift-drag ratio slightly in excess of 2.0 and was stable in pitch and sideslip over the angle-of-attack range for which it could be trimmed in pitch. Author

N68-16262*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SURVEYOR 4 MISSION REPORT: MISSION DESCRIPTION AND PERFORMANCE
1 Jan. 1968 178 p refs
(Contract NAS7-100)
(NASA-CR-92707; JPL-TR-32-1210) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Surveyor IV, the fourth in a series of seven unmanned spacecraft designed to soft-land on the moon and return engineering and scientific data, was launched from Cape Kennedy, Florida, on July 14, 1967. A nominal launch phase and accurate injection were achieved, followed by a normal transit phase including a successful midcourse maneuver. However, during terminal descent, the *Surveyor IV* radio signal was lost abruptly just prior to expected main retromotor burnout, only about 2-1/2 min before predicted soft landing. When exhaustive attempts to reestablish radio communications were unsuccessful, the mission was terminated short of the attainment of the flight objectives. A thorough investigation conducted by a formally appointed technical review board was unable to disclose any evidence of the cause for the failure. A technical description of the mission and an evaluation of engineering data obtained are presented. Author

N68-16281# Virginia Military Inst., Lexington. Research Labs.
OPTIMUM DESIGN OF SPACE SATELLITE INSTRUMENT FRAMEWORK AND PACKAGING Final Report
W. L. Patrick 31 Jul. 1967 85 p refs
(Contract Cwb-10904)
(PB-176215) CFSTI: HC $3.00/MF $0.65

A method for the optimum design of relatively small skin-rib-stringer structures is of significant importance for spacecraft instruments. This investigation attempted to develop a design method and establish a basic criteria for determining member sizes and spacing to provide minimum weight of such structures of any configuration. Of particular importance is the flexure of the ribs and stringers and the load carrying ability of the enclosing skin. The method developed attempted to include these considerations but the matrix formulated was ill-conditioned and no positive design results were achieved. Author

N68-16403*# Boeing Co., Seattle, Wash. Space Div.
MAINTAINABILITY OF MANNED SPACECRAFT FOR LONG-DURATION FLIGHTS
Jul. 1967 438 p refs
(Contract NAS2-3705)
(NASA-CR-73152; D2-113204-3, V. 3) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Several candidate manned space missions are described, such as various earth–orbital missions, Mars flyby, Venus flyby, Mars/Venus flyby, and lunar base missions. Mission characteristics are discussed in relation to the operational factors affecting space hardware design and maintenance. Subsystems used for the 1975 near–earth orbital mission and for the 1985 L_1 libration center mission are described. Data sheets providing an equipment component list by subsystem for the entire spacecraft are included, along with maintenance task analysis sheets and expendable data sheets. Similar data are given for the 1975 Mars/Venus flyby mission, the 1985 Mars landing mission, and the earth–orbital missions. A reference bibliography of source material is listed. M.G.J.

N68-16440*# Chrysler Corp., New Orleans, La. Space Div.
SA-204/LM-1 LAUNCH VEHICLE DYNAMICS ANALYSIS, PART 2
8 Jan. 1968 135 p revised
(Contract NAS8-4016)
(NASA-CR-92837; TP-AP-67-239, Pt. 2, Rev. 1) CFSTI: HC $3.00/MF $0.65 CSCL 22D

Results and descriptions of detailed (six degree of freedom) trajectory analyses applicable to the Saturn IB launch vehicle for the Apollo-Saturn 204/LM-1 mission are summarized. The documentation is divided into two sections: an integrated summary of conclusions obtained from each analysis, and a collection of technical presentations in each of which are described the study assumptions, mathematical models, analytical approaches and the results obtained. The specific analyses which are included pertain to: liftoff motion, rigid body boost flight wind limits, engine out controllability, and separation motion. The data results for the nominal and off nominal vehicle flights are presented in the form of time histories and envelopes of extreme values for significant detailed trajectory parameters. For flights in which the vehicle is subjected to extreme winds or system malfunctions, there are additional displays in the form of flight limitations imposed by launch pad obstructions, vehicle controllability requirements, vehicle structural integrity, and stage separation clearance distance. Author

N68-16475# Stanford Univ., Calif. School of Engineering.
ASCEND: ADVANCED SYSTEM FOR COMMUNICATION AND EDUCATION IN NATIONAL DEVELOPMENT Final Report
Jun. 1967 423 p refs

This report presents a brief summary of the preliminary design of communication and educational television satellites for

Brazil, India, and Indonesia. The complete study shows how Educational Television via a satellite can be integrated into the nation's educational programs, and how satellite techniques can be phased into present and future communications systems. The technical study includes an optimized design of a synchronized, fully stabilized satelite with 1 kw of RF power. It also includes detailed design of ground receivers to minimize overall systems cost for television, facsimile, and two-way voice communications. The study demonstrates that the technology is entirely capable of providing such a system at a cost which is a small fraction of what several of the countries are now spending for education. The incredible potential that this system offers for future growth in developing nations makes it imperative that the national planners be made aware of these additional alternatives. Author

N68-16505*# American Science and Engineering, Inc., Cambridge, Mass.
X-RAY ASTRONOMY EXPERIMENTS (S017 AND S069). APOLLO APPLICATIONS PROGRAM (AAP) FLIGHT, PHASE 1 Final Report, 1 Jun.–1 Nov. 1967
30 Nov. 1967 252 p
(Contract NAS9-7201)
(NASA-CR-65888; ASE-1758) CFSTI: HC $3.00/MF $0.65 CSCL 22B

The purpose of this work was to define the requirements necessary to implement the X-ray Astronomy Experiment on an Apollo Applications Program (AAP) flight. Existing S017 flight hardware was examined for incorporation into the S069 experiment which was assigned to a new carrier on an AAP mission. In particular, the Multiple Docking Adapter (MDA) for Mission AAP-2 was given prime consideration. The performance requirements and system concept for the S069 scientific instrument were established for a state-of-the-art equipment design. In addition, the engineering problems and reliability requirements associated with the integration of the scientific instrument into the MDA experiment carrier were evaluated. The proposed technical solutions are also discussed in this report. Author

N68-16553# Royal Observatory, Edinburgh (Scotland). Satellite Tracking Section.
STOPWATCH OBSERVATIONS OF SATELLITES, OCTOBER 1967
R. D. Eberst 4 Jan. 1968 26 p refs
(ROE-STS-66) CFSTI: HC $3.00/MF $0.65

Stopwatch observations made at stations connected with the section during the month of October 1967 are listed in satellite launch order and in time order for each satellite. Various sub-totals are given. Author (ESRO)

N68-16769# Applied Physics Lab., John Hopkins Univ., Silver Spring, Md.
GRAVITY-GRADIENT STABILIZATION OF SYNCHRONOUS ORBITING SATELLITES
Peter M. Bainum and Donald L. Mackison 1967 42 p refs Presented at the British Interplanet. Soc., Loughborough, England, Apr. 1967

The attitude control system for a gravity-gradient stabilized satellite in synchronous and near-synchronous equatorial orbits is analyzed using two methods for libration damping. Energy dissipation in the first is provided by the relative motion between the satellite and an asymmetrically connected auxiliary body; the second scheme utilizes the interaction of the earth's magnetic field with an on-board, time dependent magnetic dipole. Author

N68-16874 Martin Co., Denver, Colo.
TECHNOLOGY FEASIBILITY SPACECRAFT (TFS). VOLUME 3: THERMAL ANALYSIS AND TEST Final Report
Feb. 1968 121 p refs
(R-68-2, V. 3)

Thermal analysis and test effects performed for the Technology Feasibility Spacecraft (TFS) are presented, and the development and use of mathematical models of the TFS vehicle are detailed. Thermal characteristics of the TFS in its three test configurations is simulated by three basic models, with a lumped parameter approach used to establish the matnematical models. A nodal representation of each physical system was devised, and these representations were fed into a thermal analysis computer program, which solves the required heat transfer equations in finite difference form. M.W.R.

N68-16891*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPLORING IN AEROSPACE ROCKETRY 3. CALCULATION OF ROCKET VERTICAL-FLIGHT PERFORMANCE
John C. Evvard Washington 1968 18 p ref Presented at the Aerospace Explorers Meeting, NASA. Lewis Res. Center, 1966–1967
(NASA-TM-X-52390) CFSTI: HC $3.00/MF $0.65 CSCL 22D

In calculating the altitude potential of a rocket, one must take into account the forces produced by both the thrust of the engine and the gravitational pull of the earth. A simplified approach can be developed for estimating peak altitude performance of model rocket vehicles. The principles involved, however, are basic and are applicable to all rocket-powered vehicles. The method of calculating vertical-flight performance is to use Newton's law to compute acceleration. Then, velocity and vertical distance, or altitude, are computed from acceleration. Author

N68-16905*# Boeing Co., Seattle, Wash. Space Div.
MAINTAINABILITY OF MANNED SPACECRAFT FOR LONG DURATION FLIGHTS, VOLUME 2
Jul. 1967 271 p refs
(Contract NAS2-3705)
(NASA-CR-73151; D2-113204-2, V. 2) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Spacecraft of four representative but widely varying missions, one Earth-orbital and one interplanetary each in the mid-1970 and the mid-1980 time periods, are examined to the replaceable component level. Detailed maintenance analyses of subsystems and components, vehicle configuration optimizations performed with a unique computer program, and statistical results of several hundred mission simulations are described and evaluated. The effects of hardware reliability and failure rates, skills, environmental factors, mission durations and resupply potential, and various resources are considered in many interrelationships. Optimum distributions of redundant and spare items to be included on board each spacecraft configuration for assuring mission success are identified, and their implications as to operational requirements and design philosophies are discussed. Tables, charts, and graphs summarizing analytical results and displaying parametric sensitivities are provided. Gross cost estimates also are included to indicate trends and to place the respective missions in context relative to each other. Author

N68-16913*# American Science and Engineering, Inc., Cambridge, Mass.
SOUNDING ROCKET FLIGHT OF A DIRECTIONAL NEUTRON DETECTOR Final Report 29 Dec. 1966–30 Sep. 1967

28 Nov. 1967 91 p refs
(Contract NASw-1540)
(NASA-CR-92683; ASE-1708) CFSTI: HC $3.00/MF $0.65 CSCL 22B

A directional neutron detector was built, along with appropriate electronics, a sun sensing device, and a nose cone ejection system. The phosphor for the scintillation counter was constructed of small glass tubes filled with scintillation fluid encased in clear epoxy, and completely surrounded by a cosmic ray anti-coincidence shell of CsI. The experimental apparatus was integrated into a Nike-Apache sounding rocket and launched from Wallops Island, Va. on 13 June 1967. Pulse height and pulse shape information telemetered to the ground station for subsequent two parameter analysis determined the type of radiation detected, as well as its energy spectrum. Except for the inadequate rejection of cosmic ray particles, the system functioned as planned, demonstrating the suitability of this type of detector for solar neutron measurements. Author

N68-17094*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DESCRIPTION AND FLIGHT PERFORMANCE RESULTS OF THE WASP SOUNDING ROCKET
Joseph A. Yuska, James F. de Pauw, and Lowell E. Steffens Washington Feb. 1968 35 p refs
(NASA-TM-X-1518) CFSTI: HC $3.00/MF $0.65 CSCL 22D

A general description of the design and construction of the WASP sounding rocket and of the performance of its first flight are presented. The purpose of the flight test was to place the 862 pound (391-kg) spacecraft above 250,000 feet (76.25 km) on free fall trajectory for at least 6 minutes in order to study the effect of "weightlessness" on a slosh dynamics experiment. The WASP sounding rocket fulfilled its intended mission requirements. The sounding rocket approximately followed a nominal trajectory. The payload was in free fall above 250,000 feet (76.25 km) for 6.5 minutes and reached an apogee altitude of 134 nautical miles (248 km). Flight data including velocity, altitude, acceleration, roll rate, and angle of attack are discussed and compared to nominal performance calculations. The effect of residual burning of the second stage motor is analyzed. The flight vibration environment is presented and analyzed, including root mean square (RMS) and power spectral density analysis. Author

N68-17143*# Chrysler Corp., New Orleans, La. Space Div.
AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY
T. J. Wharton, A. C. Genter, and B. B. Barrett 25 Jul. 1967 141 p refs Revised
(Contract NAS8-4016)
(NASA-CR-92838; TN-AP-67-255, Rev. 1) CFSTI: HC $3.00/MF $0.65 CSCL 22D

The Apollo Saturn 204/LM-1 launch vehicle operational flight trajectory is documented. Trajectory data are tabulated for all phases of flight for which the S-IB state and the S-IVB/IU stage have functional requirements. Descriptions of the AS 204/LM-1 missions and the launch vehicle and environment are presented along with comprehensive summaries of vehicle data, subsystem characteristics, and the guidance and control modes. R.N.A.

N68-17172*# Radio Corp. of America, Moorestown, N. J.
PHASE DIFFERENCE NAVIGATION SATELLITE STUDY Final Report
Dec. 1967 452 p refs
(Contract NAS12-509)
(NASA-CR-86028) CSCL 22B

Details are presented on the phase difference navigation study. The basic principles of operation, system performance and performance requirements, implementation and cost estimates are discussed. It was concluded that the phase difference techniques offer attractive solutions to self-navigation and traffic control applications, and that the instrumentation is within the present state-of-the-art. The completed tasks are also summarized, including much of the background data and analyses for the configuring of a navigation and traffic control satellite system for the North Atlantic Ocean and its expansion to a world-wide system. Signal synchronization, digital simulation, computer design, and the height and velocity formulas are also discussed. N.E.N.

N68-17174# Martin Co., Denver, Colo.
NECHNOLOGY FEASIBILITY SPACECRAFT (TFS). VOLUME 2: VEHICLE DESIGN AND FABRICATION Final Report
Feb. 1968 126 p refs
(R-68-2, V. 2)

A full scale replica of a representative planetary lander vehicle was designed, fabricated, and assembled. The vehicle consists of an aeroshell, terminal descent stage, deorbit module, and surface science package all enclosed in a sterilization canister covered with ten layers of aluminized Mylar superinsulation. Also provided are configuration and structural similarity and thermal duplication of propellant tanks, deorbit and terminal descent engines, ablator material, thermal coatings, internal insulation, cruise mode heaters, entry science electronics, radio isotope thermoelectric generator power units, lander vehicle electronics, surface science package mass, heat generation and insulation, and sterilization canister with superinsulation. Besides the experience gained in the design and fabrication of interplanetary spacecraft, it is concluded that this program also resulted in new manufacturing techniques and processes, including fabrication and assembly of multilayer thin film superinsulation, application of thermal control coatings, and assembly and handling of very thin structures (0.02-in. aluminum simulating and 0.005-in. titanium for a sterilization canister). Quality control techniques are also described. E.C.

N68-17197*# Lockheed Missiles and Space Co., Huntsville, Ala. Research and Engineering Center.
LAUNCH AND SPACE VEHICLE CONTROL STUDIES. VOLUME 2: SPACE VEHICLE CONTROL STUDIES Final Report
22 Sep. 1967 341 p refs
(Contract NAS8-21034)
(NASA-CR-61545; LMSC/HREC-A784590, V. 2; HREC-1034-1) CFSTI: HC $3.00/MF $0.65 CSCL 22D

Several studies in the control and stabilization of space vehicle clusters are presented. The five major study areas covered include the development of equations for orbital vehicle attitude studies, passive attitude stability of space vehicle clusters, active control with control moment gyros, studies of desaturation for control moment gyros, and semi-active control systems. R.N.A.

N68-17213*# General Electric Co., Philadelphia, Pa. Spacecraft Dept.
APPLICATIONS TECHNOLOGY SATELLITE GRAVITY GRADIENT STABILIZATION SYSTEM Quarterly Progress Report, 1 May–31 Jul. 1967
20 Aug. 1967 39 p refs
(Contract NAS5-9042)
(NASA-CR-92713; Doc.-67SD4348; QPR-12) CFSTI: HC $3.00/MF $0.65 CSCL 22B

An analysis of the current technical state of the systems is presented. The tumbling of the ATS-2 has continued because

of the eccentric orbit, and predictions are that it will continue for an indefinite time. Rates were observed from 4°/min. to as high as 51°/min. The tumbling rate precluded meaningful attempts to obtain 3-axis attitude determination; however, generation of sun vector coordinates continued because of the omnidirectional characteristics of the gravity gradient system sun sensors. The ATS-2 primary booms were scissored. The Combination Passive Damper was clutched from the eddy current to the magnetic hysteresis mode. Telemetry data verified that two boom systems were successfully scissored. A profile of the scissoring and excursions of the damper boom angle in the vicinity of the clutching operation are shown. Investigation of ATS-2 boom dynamics phenomena was concluded with the finding that the observed high frequency components of boom and center body motions are explainable in terms of orbit eccentricity alone and would not have occurred if the spacecraft had been put into a circular orbit. Components of the system aboard the ATS-2 are discussed, and primary boom motions are analyzed based on latest TV data. K.W.

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N68-16113# Southampton Univ. (England). Inst. of Sound and Vibration Research.

ELEMENT STATIC FLEXIBILITY AND STIFFNESS MATRICES FOR THE FINITE ELEMENT ANALYSIS OF BEAM, PLATE AND SHELL STRUCTURES. PART 1: PLANE ELEMENTS

John Robinson Sep. 1967 85 p refs Presented at the Intern. Seminar on the Introduction to Static Structural Matrix Analysis, Southampton, Engl., Sep. 1967

(ISVR-196)

A mathematical model is presented which applies the principles of virtual displacements in deriving element static flexibility and stiffness matrices for a variety of structural elements. An equation is given, using the principle of virtual forces to derive the element static flexibility matrix. The element static flexibility matrices are also derived for general and inclined beam elements with and without distributed loading. The Airy stress function approach, which satifies the combined equilibrium and compatibility equation, is applied to simple plane stress plate elements. Equations for element static stiffness matrix are presented which consider linearly varying displacements with axial and endload elements. Rectangular and triangular plate elements equations are also stated. B.S.D.

N68-16164 United Kingdom Atomic Energy Authority, Harwell (England). Research Group.

THE AXISYMMETRIC ELASTIC/PLASTIC PROBLEM FOR A PLATE WEAKENED BY A CIRCULAR HOLE

K. N. Shevchenko (Acsd. of Sci., USSR) Nov. 1966 7 p refs Transl. into ENGLISH from Prikl. Mat. i Mekh. (Moscow), v. 15, 1951 p 519–520

Consideration is given to a closed solution of the elastic/plastic problem for a plate loaded within a circular hole by an axisymmetric load. The solution does not take into account the compressibility of a material when the law of hardening of the material is linear. The results of the calculation are given. Author

N68-16180# Westinghouse Electric Corp., Pittsburgh, Pa. Research Labs.

PHOTOELASTIC DETERMINATION OF STRESSES AT AN OPENING IN A THIN-WALLED CYLINDRICAL PRESSURE VESSEL

M. M. Leven 24 Aug. 1967 33 p refs Prepared for Oak Ridge Natl. Lab., Tenn.

(Contract W-7405-ENG-26)

(RR-67-9D7-PHOTO-R1; TID-24106) CFSTI: HC $3.00/MF $0.65

The distribution of the principal stresses on the inner and outer surfaces in the vicinity of an opening in a thin-walled cylindrical vessel subjected to internal pressure were obtained photoelastically. The ratio of the diameter of the opening to that of the vessel, d_i/D_i, was 0.129, while the ratio of the diameter to thickness of the vessel, D_i/T, was 99.1. The ratio of nominal stresses in the opening and the vessel, s/S, was 0.93. Principal stress distributions along the inner and outer surfaces were obtained for the 0° (longitudinal), 15°, 30°, 45°, 60°, 75° and 90° (transverse) sections. The maximum stresses occurred on the longitudinal section: At the fillet on the outer surface and near the corner on the inner surface. At the exterior fillet the maximum circumferential stress was 4.75 S while the peak meridian stress was found to be 3.67 S. At the inner corner the maximum circumferential stress was 3.61 S. These maximum values compared favorably with those obtained analytically by Eringen, empirically (area replacement) by Lind and others, and experimentally by Rose. Author (NSA)

N68-16220# Sandia Corp., Albuquerque, N. Mex.

ELASTIC-PLASTIC COLLAPSE OF STRUCTURES SUBJECTED TO A BLAST PULSE

Walter B. Murfin Sep. 1967 22 p refs Presented at the 37th Shock and Vibration Symp., Orlando, Fla.

(Contract AT(29-1)-789)

(SC-DC-67-1923; CONF-671031-1) CFSTI: HC $3.00/MF $0.65

A finite difference method is used to analyze the elastic–plastic, large deflection response of shell structures under blast loading. It is shown that, although the usual design methods are adequate for some conditions, they may be overconservative under other conditions. When the shell structure is surrounded by an elastic medium, elementary design methods are grossly conservative. Author (NSA)

N68-16265# California Univ., Berkeley. College of Engineering.

SHELLS IN THE LIGHT OF GENERALIZED CONTINUA

A. E. Green and P. M. Naghdi Oct. 1967 45 p refs Presented at the 2d IUTAM Symp. on the Theory of Thin Shells, Copenhagen, 5–9 Sep. 1967

(Contract Nonr-222(69))

(AM-67-13; AD-663126)

Some aspects of recent developments in the nonlinear theories of deformable surfaces (as two dimensional generalized continua), including the Cosserat surface, are outlined with a view toward their application to the (three dimensional) elastic shells. A fairly detailed development of a linear theory of an elastic Cosserat surface is presented and some features of its constitutive equations are discussed. Author (TAB)

N68-16301# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

APPLIED MECHANICS—SELECTED ARTICLES

27 Apr. 1967 21 p refs Transl into ENGLISH from Prikl. Mekhan. (USSR), v. 2, no. 3, 1966 p 10–20

(FTD-HT-66-787; AD-662462)

CONTENTS:

1. STABILITY OF A CYLINDRICAL SHELL MADE FROM A NONLINEARLY DEFORMING MATERIAL G. B. Kireyev p 1–7 refs (See N68-16302 07-32)

2. TOWARD SOLUTION OF THE DYNAMIC PROBLEM FOR A LARGE-RADIUS SPHERICAL SHELL Yu. E. Senitskiy p 8–16 refs (See N68-16303 07-32)

N68-16302# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

STABILITY OF A CYLINDRICAL SHELL MADE FROM A NONLINEARLY DEFORMING MATERIAL [USTOYCHIVOST' TSILINDRICHESKOY OBOLOCHKI IZ NELINEYNO-DEFORMIRUEMOGO MATERIALA]

G. B. Kireyev *In its* Appl. Mech. 27 Apr. 1967 p 1–7 refs (See N68-16301 07-32)

The buckling of a circular hollow cylinder subjected to uniform longitudinal compression forces distributed along its face edges is investigated, assuming considerable axial deformations. The material of the cylinder is nonlinearly elastic; an axially symmetric mode of buckling is considered, assuming a membrane-stress state prior to buckling. An equation in variations (in terms of linear and nonlinear components of the generalized stress and strain tensors) which describes the stability of the basic stress-strain state is analyzed without consideration of mass forces, assuming the coincidence of directional stress and strain tensors. The stresses and strains in the prebuckling state are added to those generated by buckling, and expressions for generalized stresses and strains are derived, assuming the preservation of initial principal axes and the smallness of additional displacements during buckling. The initial general equation of stability is rewritten, and a fifth-order differential equation with boundary conditions from it by means of integration and certain transformations. An expression which determines the attainment of the state of buckling is derived from this equation. . . . Author

N68-16303# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

TOWARD SOLUTION OF THE DYNAMIC PROBLEM FOR A LARGE-RADIUS SPHERICAL SHELL [K RESHENIYU DINAMICHESKOY ZADACHI DLYA POLOGOY SFERICHESKOY OBOLOCHKI]

Yu. E. Senitskiy *In its* Appl. Mech. 27 Apr. 1967 p 8–16 refs (See N68-16301 07-32)

The moment theory for shells is used to solve the dynamic loading problem for a flat spherical shell. The load Z(r,t) is assumed to be aperiodic and axisymmetric. Initial conditions are given. The displacement function is represented. The boundary conditions are those for a hinged support. The two fourth-order partial differential equations in the displacement function and the stress function are solved using integral transforms and representing the desired functions in terms of Fourier–Bessel series, or another series which is given. Three special cases are considered. Author

N68-16339*# Southwest Research Inst., San Antonio, Tex.

IMPEDANCE CHARACTERISTICS OF CONICAL SHELLS UNDER AXIAL EXCITATIONS, PART 1 Final Report

William C. L. Hu and Daniel D. Kana May 1967 48 p refs (Contract NAS5-10312; SwRI Proj. 02-2034) (NASA-CR-92989; QR-2) CFSTI: HC $3.00/MF $0.65 CSCL 20K

A combined analytical and experimental study is presented to demonstrate that the transfer matrix or four-pole parameters of a truncated, thin conical shell, under axial excitations, may be accurately obtained by applying membrane shell theory. A general calculation procedure is described, and the numerical results are compared with test data for three shell models with semivertax angles 0°, 15° and 30° over a frequency range from 20 to 600 cps. The excellent agreement indicates that the four-pole parameters calculated through the present analysis are adequate for vibration analyses if the input excitation frequency is appreciably lower than a theoretical singularity on the frequency spectrum inherent to the membrane shell theory. If the excitation frequency is near or above this singularity (around 6000 cps for the models considered), a more accurate bending theory of shell must be used. Author

N68-16354# California Univ., La Jolla. Dept. of the Aerospace and Mechanical Engineering Sciences.

MINIMUM-WEIGHT DESIGN OF BEAMS FOR MULTIPLE LOADING

R. Mayeda and W. Prager Mar. 1967 26 p refs (Contract N00014-67A-0109-0003) (TR-8; AD-650194) CFSTI: HC $3.00/MF $0.65

The paper discusses minimum-weight design of beams of continuously varying cross section that have to carry any one of n systems of loads. The weight per unit length is assumed to be given by W(x)=A+By(x), where A and B are constants and Y(x) is the yield moment at the cross section x. A design method is presented that remains valid for the extreme cases n=1 and n=infinity and that enables the designer to prescribe a minimum value Y sub 0 below which the yield moment is not allowed to drop. The use of the method is illustrated by examples. Author (TAB)

N68-16408# California Univ., La Jolla. Dept. of the Aerospace and Mechanical Engineering Sciences.

DIRECT NUMERICAL DETERMINATION OF STRESSES IN ELASTIC SOLIDS

Jay W. Feldmann Dec. 1967 40 p refs (Contract N00014-67-A-0109-0003) (TR-15; AD-663127)

Using Saint Venants torsion problem for purposes of illustration, this paper presents a method for the direct determination of stresses in an elastic solid. The method is compared to finite difference techniques for the determination of the stress function. For a comparable numerical effort, the new method is shown to yield superior results. Author (TAB)

N68-16414# Polytechnic Inst. of Brooklyn, N. Y. Dept. of Aerospace Engineering and Applied Mechanics.

EXPERIMENTAL AND THEORETICAL INVESTIGATION OF TEMPERATURES AND STRESSES IN ABLATING THICK WALLED HEMISPHERES

Richard F. Parisse and S. V. Nardo Nov. 1967 142 p refs (Contract Nonr-839(23)) (PIBAL-939; AD-663154)

Hypersonic wind tunnel tests of 7 3/4 inch diameter Plexiglas and Nylon hemispheres were designed and conducted at the Preston R. Bassett Laboratory of the Polytechnic Institute of Brooklyn. A shrouded model technique was utilized to simulate Mach 15 to 20 flight. The models were instrumented with thermocouples and strain gages from which continuous time histories of temperature and strain were recorded. In addition, ablation measurements were made after the models were tested. The experimental results were compared with theoretical calculations of strain, temperature and ablation. A point-symmetric ablation and temperature analysis was conducted using a heat balance technique. The assumed temperature profiles were used in a point-symmetric thermal stress

analysis in which a variation of the modulus of elasticity with temperature was approximated by using a concentric layer technique. The relative accuracy of this latter technique was determined by comparison with a perturbation solution for continuously varying modulus of elasticity. The effect of axisymmetric pressure distributions, as well as the boundary condition imposed by the model support, was considered in an axisymmetric layer analysis. A comparison between theory and experiment indicates good qualitative results and good to poor quantitative results. The details of the analyses, and the comparison between the theoretical predictions and experiment are discussed. Author (TAB)

N68-16458# California Univ., Berkeley. Div. of Applied Mechanics.
ELASTIC–PLASTIC CONTINUA WITH SIMPLE FORCE DIPOLE
A. E. Green (Newcastle Univ.), B. C. McInnis (Tulane Univ.), and P. M. Naghdi Sep. 1967 47 p refs
(Contract Nonr-222(69))
(AM-67-12; AD-663125)

The paper is concerned with a nonlinear theory of elastic-plastic continua in the presence of simple force and stress dipoles. General constitutive equations for such continua are developed and explicit restrictions are derived from thermodynamics. Infinitesimal theory is discussed as a special case and is applied to the example of torsion of an elastic-plastic, isotropic, circular cylinder. Author (TAB)

N68-16504# Naval Research Lab., Washington, D. C.
MECHANICAL ASPECTS OF THE DYNAMIC TEAR TEST SPECIMEN
G. E. Nash and E. A. Lange Sep. 1967 58 p refs
(NRL-1826; AD-663272)

The importance of dynamic fracture toughness as a controlling influence on the design and integrity of high performance structures is becoming more generally recognized. Since tear test procedures involve dynamic loading, a rigorous analysis of this test method can provide direct translation of test results into structural parameters such as fracture stress and stress intensity values of fracture mechanics in addition to tear energy values. This report concerns the development of a dynamic analysis for the two principal elements in the tear test, namely, the hammer and the specimen. Several methods of analysis for predicting the hammer force-time curves are discussed and an analysis based on simple bending theory which predicts the beam bending moments and stresses is presented. The calculated force-time relationship for the hammer was in good agreement with experimental results. The results indicate that the first peak in the hammer force-time curves is not directly related to fracture but is caused by inertia effects. For the specimen, the calculated stresses and bending moments predicted by the dynamic analysis agree fairly well with experimental values. Both calculated and experimental values of dynamic stresses and moments are lower than those calculated from a static analysis; and therefore, in the dynamic tear test a static analysis cannot be used to calculate fracture stresses or stress intensity factors. Author (TAB)

N68-16551*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SOME CURRENT TECHNIQUES IN EXPERIMENTAL AEROELASTICITY
Frank T. Abbott, Jr. [Nov. 1967] 37 p refs Presented at the Symp. on Solid-Fluid Interaction Probl. in Mech. of the ASME 1967 Winter Ann. Meeting, Pittsburgh, 12–16 Nov. 1967
(NASA-TM-X-60982) CFSTI: HC $3.00/MF $0.65 CSCL 20K

A brief review is presented of some of the techniques currently employed in the transonic dynamics wind tunnel to solve aeroelastic problems by use of dynamically and elastically scaled models. Author

N68-16625# National Lucht-En Ruimtevaartlaboratorium, Amsterdam (Netherlands).
A CALCULATION METHOD FOR NATURAL FREQUENCIES AND VIBRATION MODES OF SOLID WING MODELS OF LOW ASPECT RATIO
M. J. de Jongh and J. v. d. Vooren 20 Dec. 1966 85 p refs
(NLR-TN-F.260)

A Rayleigh–Ritz method is presented to calculate the natural frequencies and vibration modes of solid wing models of low aspect ratio. A power series has been chosen to approximate the vibration modes as well as the wing thickness distribution. To verify the method natural frequencies and mode shapes have been computed for some models which already had been investigated experimentally. The calculated results show good agreement with the tests. Author

N68-16669*# New York Univ., N. Y.
DYNAMIC BEHAVIOR OF RECTANGULAR PLATES AND CYLINDRICAL SHELLS
Edward N. Wilson and Are Tsirk Oct. 1967 134 p refs
(Grant NGR-33-016-067)
(NASA-CR-92881; S-67-7) CFSTI: HC $3.00/MF $0.65 CSCL 20K

A numerical procedure is presented for the determination of the dynamic response of rectangular plates and cylindrical shells subjected to stationary time dependent loads as well as to multiple loads moving with constant velocity along any path on the structure. The masses of the moving loads are included in the analysis. Finite element models are adopted to reduce the continuous media of the plate and the cylindrical shell to systems having a finite number of degrees of freedom, with inertia forces concentrated at a finite number of nodes. Displacement functions are assumed for each of the constituent elements to obtain node forces equivalent to the applied loading. The displacement method of analysis is employed, considering three and six degrees of freedom at each node for the plate and shell model, respectively, to obtain a set of simultaneous differential equations describing the motion of the models. These equations are solved by a step-by-step numerical integration technique to find the displacements and the concentrated forces at the nodes of the models. Author

N68-16670* University of Southern Calif., Los Angeles. Dept. of Civil Engineering.
IMPACT STRESSES AND DEFORMATIONS IN SPHERICAL SHELLS Progress Report
M. P. Bieniek Jan. 1968 107 p
(Grant NGR-05-018-056)
(NASA-CR-92976) CFSTI: $3.00 CSCL 20K

Impact stresses and deformations in spherical shells were investigated. General properties of the stress waves in spherical shells were studied. The types and velocities of stress waves have been determined for membrane theory, bending theory, and bending-shear theory. The method of modal expansion was developed for axially symmetric dynamic problems of spherical shells within the membrane, bending, and bending-shear theories. A numerical method based on the theory of characteristics has been developed for the membrane and bending shear theories. The analysis of impact stresses in a spherical shell colliding with an elastic.

Winkler-type of foundation was performed. The general equations have been developed for the membrane and bending-shear theories of shells. Certain numerical results have been obtained for the membrane theory. Author

N68-16694# California Univ., Berkeley. Div. of Aeronautical Sciences.

FIRST ORDER FREQUENCY EFFECTS IN SUPERSONIC PANEL FLUTTER OF FINITE CYLINDRICAL SHELLS

Ting-Mau Li (Ph.D. Thesis) Aug. 1967 51 p refs
(Grants AF-AFOSR-268-67; NSF GK-1297)
(AS-67-16; AFOSR-67-2591; AD-661328)

The flutter boundary of a thin cylindrical shell of finite length is determined with the aerodynamic load obtained by linearized potential theory. A low frequency approximation is applied, together with some other plausible approximation, to circumvent the difficulty in evaluating a complicated convolution integral containing Bessel functions. Galerkins method is then used to set up an eigenvalue problem equivalent to the resulting integro-differential equation. The flutter boundary, for given Mach number and circumferential mode n, corresponds to the shell thickness ratio at which the real part of any one of the eigenvalue first become non-negative. Some interesting conclusions can be drawn, at least qualitatively, through Hadamards well known theorem on the regularity of a matrix. In particular, it is found that the most feasible circumferential mode of vibration occurs around n=7. Author (TAB)

N68-16696* Douglas Aircraft Co., Inc., Santa Monica, Calif. Missiles and Space Systems Div.

APPLICATION OF DISTRIBUTED SYSTEM CONCEPTS TO ANALYSIS OF BENDING VIBRATION

Carley C. Ward 5 Oct. 1966 30 p refs Presented at the SAE Natl. Aeron. and Space Eng. Meeting, Los Angeles
(NASA-CR-92807; Douglas Paper-4119) CSCL 20K

As an alternative to the normal mode approach to the dynamics and controls analysis of flexible aerospace vehicles, the analysis of bending vibration is being studied in terms of the distributed system concepts of propagation and reflection. A relationship is developed between the vibration equation of motion and the propagating wave equation. Transmission matrices, including the effects of shear compliance and rotary inertia, are developed for uniform beam segments. Through a transformation technique, the local state variables are changed to characteristic variables of the beam permitting factorization of the solution into propagation and end-effect matrices. The technique is applied to a cascaded or step beam structure and a beam structure combined with a damped spring mass sloshing model. The advantages and disadvantages of the distributed parameter transmission matrix approach are investigated and the use of this approach for the dynamic analysis of aerospace vehicles is evaluated. Author

N68-16702*# Wyle Labs., Inc., Huntsville, Ala.

THEORETICAL AND EXPERIMENTAL RESPONSE OF PANELS TO TURBULENT BOUNDARY LAYER PRESSURE FLUCTUATIONS AND SEPARATED FLOW. SOME PRELIMINARY RESULTS

M. J. Crocker Jul. 1967 84 p refs
(Contract NAS8-5384)
(NASA-CR-61555; WR-67-8) CFSTI: HC $3.00/MF $0.65 CSCL 20K

A method was developed which predicts the response of simply-supported panels to turbulent boundary layer pressure fluctuations. This method, in conjunction with the digital computer program presented, can also be used to predict full scale structural response to turbulence, and for this case novel methods have been developed to describe the empirical expressions for the narrow band wall pressure space correlations, necessary for the computations. Experimental success has also been achieved in setting up repeatable separated flow with small longitudinal wall pressure gradients. The basic experimental techniques for measuring panel response were developed. Unfortunately, difficulty was experienced in constructing a sufficiently uniform panel. Results for the panel actually used are given, but are thought to be unrepresentative. Author

N68-16737# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.

LION TALES: A USERS' MANUAL FOR THE LION THERMAL-STRUCTURAL EVALUATION CODE

W. W. Fischer 31 Jul. 1967 178 p refs
(Contract W-31-109-ENG-52)
(KAPL-M-6533) CFSTI: HC $3.00/MF $0.65

LION TALES presents details pertinent to the use of the LION code when applied to transient and steady state thermal-structural temperature distribution problems. The code is described briefly followed by input description for basic and optional features usage as well as for certain setup techniques. Details are given for completing each type of punchcard used. Included also are details of the code verification made by means of comparison to analytical results for a rather severe transient. Author (NSA)

N68-16746*# New York Univ., N. Y. School of Engineering and Science.

OPTIMUM RELAXATION TIME FOR A MAXWELL CORE DURING FORCED VIBRATION OF A ROCKET ASSEMBLY

Bernard W. Shaffer and Robert I. Sann (Bendix Corp., Teterboro, N. J.) Dec. 1967 14 p refs
(Grant NGR-33-016-067)
(NASA-CR-92986; S-67-8) CFSTI: HC $3.00/MF $0.65 CSCL 20K

It is the purpose of this note to prove the existence of an optimum relaxation time for an assembly consisting of a solid cylinder bonded to a thin casing, if the cylinder is made of a material which is a Maxwell solid. When the core of the viscoelastic assembly is made of a Maxwell solid, an optimum relaxation time is found which minimizes the displacement amplitude and the bond stress response at resonance. For a Voigt solid the displacement amplitude and the bond stress response at resonance decreases with retardation time, but no optimum time exists in the same sense. Author

N68-16810# California Univ., Berkeley. Div. of Applied Mechanics.

THE COSSERAT SURFACE

A. E. Green and P. M. Naghdi Aug. 1967 25 p refs
(Contract Nonr-222(69))
(AM-67-11; AD-663124)

An account of a general theory of a Cosserat surface is presented and some special cases, including some features of the linear theory of an elastic Cosserat plate, are discussed. Author (TAB)

N68-16877# Illinois Univ., Urbana. Dept. of Civil Engineering.

A LARGE DEFLECTION ANALYSIS METHOD FOR ELASTIC—PERFECTLY PLASTIC CIRCULAR PLATES

J. G. Crose (Ph.D. Thesis) and A. H. S. Ang Jun. 1967 113 p refs *Its* Struct. Res. Ser.-323
(Grant NSF GK-589)
(PB-175611) CFSTI: HC $3.00/MF $0.65

A numerical technique has been presented to analyze elastic–plastic plates without the usual assumptions of small deflections. By using a lumped-parameter model the continuous plate is replaced by one with a finite number of degrees of freedom. The field equations are then derived directly from the model for large deflection geometry. These equations turn out to be a finite difference approximation to the corresponding 'exact' differential equations. Hence, a solution formulated through the model can be shown to tend to the corresponding problem of a continum. Although the solution method is described and used herein for circular plates of elastic-perfectly plastic material, the method is equally applicable for other material equations. Author

N68-17045*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ELASTIC-PLASTIC TORSION PROBLEM FOR STRAIN-HARDENING MATERIALS
Alexander Mendelson Washington Feb. 1968 23 p refs
(NASA-TN-D-4391) CFSTI: HC $3.00/MF $0.65 CSCL 20K

A simple and straightforward procedure is presented for solving the elastic-plastic problem for the torsion of a solid prismatic bar made of a strain-hardening material. The procedure is based on the method of successive elastic solutions or successive approximations. For circular cross sections, the problem reduces to the solution of a nonlinear algebraic equation. For the case of a circular cross section with linear strain hardening, the solution is obtained in closed form. Results are presented for bars of rectangular and circular cross sections with linear strain hardening. Author

N68-17047*# National Aeronautics and Space Administration, Washington, D. C.
INFLUENCE OF INITIAL LOADING OF DIFFERING DEGREE AND DIFFERING FREQUENCY ON THE FATIGUE STRENGTH OF DRILLED FLAT BARS OF STEEL ST 37. PART B: MULTISTAGE AND SERVICE STRENGTH TESTS [EINFLUSS UNTERSCHIEDLICH HOHER UND HAEUFIGER VORBELASTUNGEN AUF DIE SCHWINGFESTIGKEIT GEBOHRTER FLACHSTAEBE AUS ST 37. TEIL B: MEHRSTUFEN- UND BETRIEBSFESTIGKEITSVERSUCHE]
E. Gassner and W. Schuetz Dec. 1967 17 p Transl. into ENGLISH from Lab. fuer Betriebsfestigkeit Rept. FB-58
(NASA-TT-F-11241; FB-58) CFSTI: HC $3.00/MF $0.65 CSCL 20K

Experiments for determining the fatigue strength of drilled flat steel bars, under the influence of various initial stresses in multi-stage and operating strength tests, are discussed. The individual tests are described in detail, giving the load cycles, stress ratios, testing frequencies, and type of material (tempered and untempered bars). Cumulative damage hypotheses, specifically the Palmgren-Miner rule, are critically evaluated and disproved. Author

N68-17062# IIT Research Inst., Chicago, Ill.
STUDIES OF REACTOR CONTAINMENT. VOLUME 2: DETERMINATION OF THE EQUATION-OF-STATE OF POROUS SOLIDS Final Report
Paul Lieberman Oct. 1967 105 p refs
(Contract AT(11-1)-578)
(IITRI-578P21-22) CFSTI: HC $3.00/MF $0.65

A helium/air shock tube is designed to give controlled blast waveforms for impingement against a porous solid contained in a special specimen holder. The sensors in the specimen holder are arranged to detect elastic wavefront, plastic wavefront, reflected plastic wavefront, unloading wavefront, particle velocities in the crushing solid, and gas pressure in the impingement gases. The data records are interpreted in terms of a wave diagram from the pressure-time histories at several stations along the specimen holder. The wave diagrams for several blast impingement pressures are combined to construct the equation-of-state of the porous solid in loading and in unloading. The stress-volume relations in shock loading, isentropic unloading and shock reloading for Celotex, styrofoam, redwood, sugar pine, foamglass and balsa were obtained at normal stresses of 300 to 17,000 psi. Wall friction effects and Malvern-type strain-rate sensitivity effects are considered. The choosing of materials and the designing of blast shields in connection with reactor containment are discussed. Author (NSA)

N68-17068*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ACCURACY STUDY OF FINITE DIFFERENCE METHODS
Nancy Jane Cyrus and Robert E. Fulton Washington Jan. 1968 29 p refs
(NASA-TN-D-4372) CFSTI: HC $3.00/MF $0.65 CSCL 20K

A method for studying the accuracy of finite difference approximations for linear differential equations is presented and utilized. Definitive expressions for the error in each approximation are obtained by using Taylor series to derive the differential equations which exactly represent the finite difference approximations. The resulting differential equations are accurately solved by a perturbation technique which yields the error directly. This method is used to assess the accuracy of two alternate forms of central finite difference approximations for solving boundary value problems in structural analysis which are governed by certain equations containing variable coefficients. A "half station approximation" in which finite difference approximations are made before expanding derivatives of function products is compared with a "whole station approximation" in which derivatives of function products are expanded first for string, beam, and axisymmetric circular plate problems. An example of a square membrane is given as an application of the method to partial differential equations. Author

N68-17133# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STRUCTURAL MECHANICS AND CALCULATION OF CONSTRUCTIONS
4 May 1967 58 p refs Transl. into ENGLISH from the Publ. "Stroitel'naya Mekhanika i Raschet Sooruzheniy" Moscow, Akad. Stroit. i Arkhitekt. SSSR, 1963, no. 3 p 1–19
(FTD-MT-66-24; AD-663367)

CONTENTS:

1. COMPUTERS AND CALCULATION OF CONSTRUCTIONS A. V. Gemmerling p 1–12 refs (See N68-17134 07-32)
2. CONCERNING THE QUESTION OF SOLUTION OF TWO-DIMENSIONAL PROBLEM OF THEORY OF ELASTICITY BY ANALOGY METHOD WITH BENDING OF PLATE G. A. Geniyev p 13–19 refs (See N68-17135 07-32)
3. STEREOPHOTOGRAMMETRIC METHOD OF MEASUREMENT OF DEFORMATIONS OF THREE-DIMENSIONAL STRUCTURES P. I. Polyakov and M. Z. Taranovskaya p 21–30 ref (See N68-17136 07-32)
4. TOWARD CALCULATION OF BEAMS ON ELASTIC SUPPORTS P. P. Suvorovskiy p 31–37 refs (See N68-17137 07-32)
5. CALCULATION OF RODS FROM PLASTICS ON BUCKLING V. P. Kotsegubov p 39–47 refs (See N68-17138 07-32)

N68-17134# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
COMPUTERS AND CALCULATION OF CONSTRUCTIONS [VYCHISLITEL'NYYE MASHINY I RASCHET SOORUZHENIY]
A. V. Gemmerling *In its* Structural Mech. and Calculation of Construct. 4 May 1967 p 1–12 refs (See N68-17133 07-32)

This article discusses the application of digital computers in the designing of buildings, town planning, material selection, etc. Author

N68-17135# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CONCERNING THE QUESTION OF SOLUTION OF TWO-DIMENSIONAL PROBLEM OF THEORY OF ELASTICITY BY ANALOGY METHOD WITH BENDING OF PLATE [K VOPROSU RESHENIYA PLOSKOY ZADACHI TEORII UPRUGOSTI METODOM ANALOGII S IZGIBOM PLASTINKI]
G. A. Geniyev *In its* Structural Mech. and Calculation of Construct. 4 May 1967 p 13–19 refs (See N68-17133 07-32)

This article proposes a method of solving the two-dimensional problem in elasticity theory on plate models based on the correspondence of expressions for stresses in the two-dimensional problem to expressions for curvatures and torsion of the middle surface of the bent plate. Author

N68-17136# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STEREOPHOTOGRAMMETRIC METHOD OF MEASUREMENT OF DEFORMATIONS OF THREE-DIMENSIONAL STRUCTURES [STEREOFOTOGRAMMETRICHESKIY METOD IZMERENIYA DEFORMATSIY PROSTRANSTVENNYKH KONSTRUKTSIY]
P. I. Polyakov and M. Z. Taranovskaya *In its* Structural Mech. and Calculation of Construct. 4 May 1967 p 21–30 ref (See N68-17133 07-32)

This article gives brief characteristics of the stereophotogrammetric method of measurements and describes experimental works on application of stereophotogrammetric equipment for determining the deformations of three-dimensional structures. The prospects of subsequent use of this progressive measuring technology in construction are considered. Author

N68-17137# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TOWARD CALCULATION OF BEAMS ON ELASTIC SUPPORTS [K RASCHETU BALOK NA UPRUGIKH OPORAKH]
P. P. Suvorovskiy *In its* Structural Mech. and Calculation of Construct. 4 May 1967 p 31–37 refs (See N68-17133 07-32)

Calculation of solid beams for elastically settling supports most frequently leads to a system of five-termed canonical equations requiring intermediate computations with a considerable quantity of significant digits for solution. This article proposes a method based on the introduction of gradually more complicated basic systems into the calculation. Author

N68-17138# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CALCULATION OF RODS FROM PLASTICS ON BUCKLING [RASCHET STERZHNEY IZ PLASTMASS NA PRODOL'NYY IZGIB]
V. P. Kotsegubov *In its* Structural Mech. and Calculation of Construct. 4 May 1967 p 39–47 refs (See N68-17133 07-32)

This article considers calculation of plastic rods for buckling by the method of limiting states. The weight and strength of different plastic girders are compared. Author

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N68-16141# Los Alamos Scientific Lab., N. Mex.
MONTE CARLO METHODS FOR THE SOLUTION OF HEAT TRANSFER PROBLEMS, INCLUDING HYBRID COMPUTER TECHNIQUES FOR MONTE CARLO
Marilyn Treiman, comp. 25 Oct. 1967 5 p refs
(Contract W-7405-ENG-36)
(LA-3777-MS) CFSTI: HC $3.00/MF $0.65

Thirty references published since 1960 which include books, reports, and journal articles on Monte Carlo methods (especially in conjunction with hybrid computers) used for the solution of heat transfer problems are given. References are arranged alphabetically by first author. NSA

N68-16146# Institut Franco-Allemand de Recherches, St. Louis (France).
TEMPERATURE MEASUREMENT IN THE WAKE OF A SPHERE SHOT AT HYPERSONIC VELOCITY [MESURES DE TEMPERATURE DANS LE SILLAGE D'UNE SPHERE LANCEE A VITESSE HYPERSONIQUE]
H. Mach and J. Vauvrecy 29 Nov. 1966 33 p refs In FRENCH
(ISL-T-33/66)

Hypervelocity Dural bullets were fired at 2 at pressure into an argon atmosphere and the observed Al ablation lines at 3961/44 Å and 3091 Å were measured spectrometrically as functions of time. Aluminum vapor excitation temperature was determined by correlation of both line intensities. Measured temperatures of 3500°K to 4500°K in the bullet wake compared favorably with the estimated particle density of 10^{14} to $10^{15}/cm^3$. Author

N68-16155# Institut Franco-Allemand de Recherches, St. Louis (France).
DETERMINATION OF THE ELECTRON TEMPERATURE OF AN Al HOLLOW CATHODE LAMP CALIBRATION USES [BESTIMMUNG DER ELEKTRONENTEMPERATUR EINER Al-HOHLKATHODENLAMPE FUER EICHZWECKE]
H. Mach 10 Aug. 1966 25 p refs In GERMAN
(ISL-T-19/66)

A mercury lamp was used to calibrate a spectrophotometric apparatus, consisting of a double monochromator, a photomultiplier, and a galvanometer in order to determine the Al 3081/92 and Al 3944/62 spectral line intensities of the hollow aluminum cathode as a function of current density. A value of about 200 $\mu W/cm^2$ ster was found at 15 mA. Correlation of the double line intensities established the excitation temperature of the lamp in an optical thin layer as 15,000°K at a current density of 10 mA; intensity decreased with increased current density. Author

N68-16158# Institut Franco-Allemand de Recherches, St. Louis (France).

TEMPERATURE DETERMINATION IN MAGNESIUM FLAMES [TEMPERATURBESTIMMUNG IN MAGNESIUM-FLAMMEN]

F. Roessler 1 Sep. 1966 50 p refs In GERMAN
(ISL-5/66)

Calculated are radiative properties of a simple, and of a self-reflecting magnesium oxide flame. Optical thicknesses and real temperatures are derived by combining black body radiation values of the simple and the self-reflecting flame and by reducing the dispersion of the absorption coefficient from the thermal radiation of an opaque flame. Dispersion of the scattering coefficient is obtained from an optical thick flame and the absorption value for an infinite thick layer is found from literature. Graphic curves of the four values are then used to determine the temperature from black body radiation and thermal radiation. Author

N68-16160# Institut Franco-Allemand de Recherches, St. Louis (France).

RADIATION MEASUREMENT OF MAGNESIUM FLAMES [STRAHLUNGSMESSUNGEN AN MAGNESIUM FLAMMEN]

F. Roessler 1 Jul. 1966 127 p refs In GERMAN
(ISL-T-15/66)

Optical thickness, real temperature, absorption coefficient dispersion, and scattering coefficient dispersion values are used to characterize a diffuse radiating magnesium oxide flame. Black body and thermal temperature measurements together with measurements on a self-reflecting flame are analyzed to obtain the values for all four parameters. Measurements show that the self reflecting effects in an opaque flame barely effect the radiative temperature and that an optical thick flame is necessary to determine the dispersion of the scattering coefficient. Author

N68-16182# Central Mechanical Engineering Research Inst., Durgapur (India).

THE EFFECT OF SOUND ON FORCED CONVECTION HEAT TRANSFER TO AIR FLOWING IN A HORIZONTAL TUBE WITH UNIFORM HEAT FLUX

C. B. Baxi and L. Krishnamurthy Sep. 1967 12 p refs Presented at the 11th Congr. of the Indian Soc. of Theoret. and Appl. Mech., Coimbatore, India, 28–31 Dec. 1966
(A10)

The effect of sound on the forced convection heat transfer coefficient of air flowing in an electrically heated horizontal tube is investigated. Sound at resonant frequency of 570 cps, as well as non-resonant frequencies was imposed on the air flowing at Reynolds number of 1000 to 6200. It was found that the resonant sound of sufficient intensity increases the heat transfer coefficient by up to 65 per cent in the laminar region and by 12 per cent in the turbulent region. It is suggested that this increase is due to combination of artificial turbulence aiding mixing, premature transition and the standing waves set up by the resonant sound field. Author

N68-16300*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

POTENTIAL USE OF HIGH FREQUENCY INDUCTION HEATING FOR HIGH TEMPERATURE LIQUID METAL HEAT TRANSFER TESTING

John V. Miller Washington Feb. 1968 50 p refs
(NASA-TM-X-1510) CFSTI: HC $3.00/MF $0.65 CSCL 20M

To investigate potential methods of obtaining high temperature liquid metal heat transfer data, several heating devices were examined and the problems of each are discussed. One promising method is high frequency induction heating. The heating coil is physically separated from the test section, is maintained at a lower temperature than the test section, and therefore, can be constructed of low temperature materials. A thick walled cylinder, internally cooled with liquid metal, was analyzed to evaluate the characteristics of an inductively heated test section. Results indicate that, if the ratio of cylinder radius to current depth is greater than 6, internal heat generation in the cylinder's center is negligible. With a tungsten cylinder, high frequency equipment can obtain the necessary cylinder-radius to current-depth ratio without exceeding allowable thermal stress levels for tungsten. Based on an error analysis of an inductively heated test section, experimental determination of liquid metal heat transfer coefficients at high heat flux levels can be made to an accuracy of ±10% for reasonable tolerances on thermocouple placement and temperature measurements. Author

N68-16324*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

ANALYTICAL COMPARISON OF RANKINE CYCLE SPACE RADIATORS CONSTRUCTED OF CENTRAL, DOUBLE, AND BLOCK-VAPOR-CHAMBER FIN-TUBE GEOMETRIES

Henry C. Haller and Seymour Lieblein Washington Feb. 1968 62 p refs
(NASA-TN-D-4411) CFSTI: HC $3.00/MF $0.65 CSCL 13A

An analytical comparison of flat direct-condensing radiators constructed of three different finned tube geometries was made over a wide range of design variables for a 500-day mission, 500-kilowatt output high-temperature Rankine space electric power generating system which used potassium as the cycle working fluid. The fin-tube configurations considered were the central, the double, and the block vapor-chamber geometries. The solid conducting fin geometries (central and double fin) were composed of stainless-steel-clad copper fins. The vapor-chamber fin radiator was evaluated for both stainless-steel-clad and all stainless-steel fins. The vapor-chamber fin-tube radiator consistently showed a significantly lower weight per kilowatt output (specific weight) than the two solid conducting fin radiators. A relatively small reduction in planform area per kilowatt output (specific planform area) at least weight condition was indicated for the vapor-chamber fin-tube radiator compared with the solid conducting fin-tube configurations. In general, the vapor-chamber fin-tube radiator can utilize larger tube diameters and fewer number of tubes than the solid conducting geometries with the least increase in specific weight and planform area. Author

N68-16337# European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center.

LUPO: A PROGRAM FOR PREDICTION OF STEADY-STATE TEMPERATURE, FLOW RATE AND PRESSURE DROPS IN A CLOSED PRESSURIZED WATER LOOP WITH OR WITHOUT BOILING

G. Gaggero and B. Panella Brussels Nov. 1967 113 p refs
(EUR-3643.e)

A method is described for predicting steady-state bulk fluid temperature, void fraction, pressure drops and mass flow rate in a closed pressurized water loop, operating at forced or natural circulation. The model treats the one-dimensional transfer of mass, momentum and energy throughout the whole liquid, subcooled boiling and bulk boiling regions of the coolant using semiempirical heat transfer and pressure drop correlations developed by other investigators. A representation of subcooled boiling, based upon the model proposed by Bowring in HPR-10, is used. Variations in heat transfer and hydraulic characteristics of the coolant due to changes in temperature and state are handled by continuously calculating local values of thermodynamic and physical properties. The method was programmed for the IBM 7090 and IBM 360/65 computers by using FORTRAN IV language. The code, named LUPO, is

described in this report, along with the numerical treatment and calculation procedure. A comparison with experimental data is presented. Author

N68-16379*# California Univ., Berkeley. Propulsion Dynamics Lab.
GASDYNAMICS OF EXPLOSIONS AND ITS RELEVANCE TO PROPULSION
Anthony K. Oppenheim *In* Office of Aerospace Res. Proc. of the OAR Res. Appl. Conf., 14 Mar. 1967 Mar. 1967 p 39–56 refs Supported jointly by NASA and AF Office of Sci. Res. (See N68-16376 07-34)

The subject of Gasdynamics of Explosions concerns the interrelationship between molecular processes resulting in the deposition of a significant amount of power in the working substance and the continuum mechanics of its concomitant, non-steady motion. It is demonstrated that acquisition of knowledge in this field should be instrumental in extending the performance range of rocket propulsion systems, and recent advances in the subject are reviewed. These were due primarily to novel insight into gaseous detonation phenomena that has been achieved by the use of a variety of modern experimental techniques, such as laser-schlieren photography yielding a multi-frame sequence of records, each with an effective exposure of about a nanosecond, produced at a megacycle frequency; pressure transducers with sub-microsecond rise-time; as well as direct recording of the traces of the multi-wave intersections that are typical of the gasdynamic processes associated with the deposition of high power in a compressible medium. Author

N68-16407 United Kingdom Atomic Energy Authority, Harwell (England). Research Group.
THERMAL FIELDS AND HEAT FLUXES. PART 1: GRAPHICAL STUDY OF STEADY AND VARIABLE CONDITIONS. CHAPTER 3: GRAPHICAL METHODS FOR VARIABLE CONDITIONS. LINEAR THERMAL FIELD AND UNIDIRECTIONAL HEAT FLOW THROUGH A WALL
Nov. 1966 108 p refs Transl. into ENGLISH from Bull. Tech. de la Soc. Franc. des Construct., no. 23, 1950 p 73–119

Flat, cylindrical and spherical walls having free isothermal surfaces where the flow is in one dimension are considered along with walls having specific section or form, or having nonisothermal boundary surfaces, where the flow is in two or three dimensions. The isothermal surfaces are planes parallel to the two free faces of the wall, the flow lines being straight lines normal to these faces. The isothermal surfaces move in time. The temperature $\tau(t,x)$ which obtains at each instant t at the different depths x (moving isochrones) is deterimed. The solution is embodied in a diagram which provides an immediate understanding of instantaneous thermal fields where the vertical isotherms are separated by a given value of Δt and have abscissae $x(\tau,t)$, which can be read at sight on the diagram obtained, where the horizontal isotherms and the isochrones $\tau(x,t)$ intersect. This type of diagram also gives a direct representation of the heat flux densities. Author

N68-16463# General Electric Co., Schenectady, N. Y. Research and Development Center.
HEAT TRANSFER AND HYDRAULICS. THE EFFECTS OF SUBCOOLED VOIDS Quarterly Report, Jul.–Sep. 1967
F. W. Staub and G. Walmet Sep. 1967 41 p refs
(Contract AT(30-1)-3679)
(QR-2; NYO-3679-2; EURAEC-1936; S-67-1161) CFSTI: HC $3.00/MF $0.65

The construction of a low pressure test loop for the measurement of the initiation and early development of the subcooled void profile was completed. Joints with defective threads were repaired and the make-up and main pump seals were replaced. The test stand design was modified and completed except for final wiring and shielding. The electrical power supply was completed and performed satisfactorily when tested. The prediction method for the net void inception point has been extended to large aspect ratio rectangular channels with either one or both walls heated. Results of the analysis were compared with available data. A data reduction method for the evaluation of the radial from the experimental chordal void profile in circular tubes was prepared. Design of the circular test section for measuring void profiles, pressure drop, and heat transfer coefficients at a reduced pressure was completed and requests for bids initiated. The test loop was modified to accommodate the desired range of test variables and to yield greater flexibility in loop operation. NSA

N68-16600# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
HEAT TRANSFER OF AN INCOMPRESSIBLE FLUID AT A THREE DIMENSIONAL STAGNATION POINT
R. Chow Jan. 1968 28 p refs
(RE-316)

The problem of heat transfer in an incompressible, viscous, heat-conducting fluid flow at a three dimensional stagnation point is investigated. The emphasis is placed on the effects of Prandtl number of the working fluid. The closed form solution for the temperature up to the second order has been obtained through the asymptotic analysis at large Prandtl number. The desired heat transfer formula shows good agreement with existing numerical integration for the two dimensional case even at Prandtl number less than unity. Therefore, the theory can be applied with good accuracy to heat transfer calculation of a large variety of incompressible fluids. Author

N68-16628* United Nuclear Corp., White Plains, N. Y. Development Div.
EXPERIMENTAL DATA FOR THE EFFECTIVE THERMAL CONDUCTIVITY OF SOLID AND POROUS TUNGSTEN IN VACUUM AND HYDROGEN ATOMOSPHERES Supplementary Report
S. L. Israel, T. D. Hawkins, and S. C. Hyman 1 Aug. 1965 303 p refs
(Contract NAS3-3205)
(NASA-CR-54429; UNC-SEEO-317) CSCL 20M

This report contains experimental data obtained in a program to determine the effective thermal conductivity of solid and porous tungsten in vacuum and hydrogen atmospheres. The data are temperature distributions measured on the top surface of cylindrical specimens heated by r–f induction currents. Author

N68-16650# Los Alamos Scientific Lab., N. Mex.
THE EFFECT OF VIBRATION ON HEAT PIPE PERFORMANCE
J. E. Deverall 22 Nov. 1967 7 p refs
(Contract W-7405-ENG-36)
(LA-3798; UC-38) CFSTI: HC $3.00/MF $0.65

A water heat pipe was operated while being subjected to typical sinusoidal and random vibrations encountered during a missile launch to determine the effect of vibration on heat pipe performance. The results of the experiment indicate that vibration tends to improve heat pipe performance as it promotes better wetting of the wick structure by the fluid. Author (NSA)

N68-16663*# United Aircraft Corp., East Hartford, Conn. Research Labs.

ANALYTICAL STUDY OF CATALYTIC REACTORS FOR HYDRAZINE DECOMPOSITION Quarterly Progress Report, 15 Oct. 1967–14 Jan. 1968

A. S. Kesten Jan. 1968 25 p refs

(Contract NAS7-458)

(NASA-CR-92988; G-910461-21; QPR-6) CFSTI: HC $3.00/MF $0.65 CSCL 21B

The debugging and running of the computer program representing the two-dimensional steady-state model of a distributed-feed catalyzed hydrazine decomposition reaction chamber. Calculated were the effects on steady-state temperature and reactant concentration distributions of nonuniform radial injection and of catalyst bed configu ations exhibiting both radial and axial nonuniformities. Empirical predictions were developed of one-dimensional steady-state temperature and fractional ammonia dissociation profiles in hydrazine reactors packed with Shell 405 catalyst particles. The empirical correlations are based on runs made with the steady-state computer program. Fractional ammonia dissociation and bulk fluid temperature are easily predicted for a broad range of operating conditions for cases in which most of the hydrazine decomposition occurs in the first few tenths of an inch of the reactor; this rapid hydrazine decomposition rate is associated with reactors packed with particles 25 mesh or smaller for approximately 0.2 in. Author

N68-16681*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

CALCULATION OF TOTAL THERMAL CONDUCTIVITY OF IONIZED GASES

Warren F. Ahtye Nov. 1967 15 p refs Presented at the 7th Conf. on Thermal Conductivity, Natl. Bur. of Std., Gaithersburg, Md., 13–16 Nov. 1967

(NASA-TM-X-60857) CFSTI: HC $3.00/MF $0.65 CSCL 20M

The suitability of the Boltzmann equation for calculating transport coefficients of partially ionized gases is discussed. Analytical and experimental investigations are cited to show that it can be used as a starting point to calculate the total thermal conductivity. The Chapman–Enskog solution of the Boltzmann equation is used to derive an expression for the total thermal conductivity, composed of three parts—the translational, reactive, and thermal diffusive components. The reactive and thermal diffusive components are explicitly expressed in terms of the multicomponent and thermal diffusion coefficients. Effects of higher order Sonine expansion terms are examined for the various transport coefficients. The first three orders of the Sonine expansion terms are required for the accurate calculation of the translational thermal conductivity, whereas only the first two orders are sufficient for the calculation of the multicomponent and thermal diffusion coefficients. These diffusion coefficients are then used to calculate the reactive and thermal diffusive components of the total thermal conductivity of hydrogen, nitrogen, and argon at conditions where the reactive component is at a maximum. Author

N68-16683*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

MINIMUM FILM-BOILING HEAT FLUX IN VERTICAL FLOW OF LIQUID NITROGEN

Frederick F. Simon, S. Stephen Papell, and Robert J. Simoneau Washington Feb. 1968 36 p refs

(NASA-TN-D-4307) CFSTI: HC $3.00/MF $0.65 CSCL 20M

A study was made of the minimum film-boiling heat flux of liquid nitrogen flowing in a vertical, electrically heated tube. Inlet liquid velocities up to 3 meters per second were studied for reduced pressures P/P_c of 0.071, 0.20, and 0.40. An analysis of the wall conduction was used to predict the wall temperatures occurring at the minimum heat flux for an electrically heated system. The predicted wall temperatures were then used in conjunction with a heat-transfer analysis for predicting the minimum heat flux. The analytical results are in good agreement with the experimental data. Author

N68-16697# European Atomic Energy Community, Ispra (Italy).

HEAT TRANSFER IN WATER WITH FORCED CIRCULATION IN THE 140–250 BAR PRESSURE RANGE—RESULTS OF INVESTIGATIONS [WAERMEUEBERGANG AN WASSER BEI ERZWUNGENER STROEMUNG IM DRUCKBEREICH VON 140 BIS 250 BAR DARSTELLUNG DER VERSUCHSERGEBNISSE]

H. Herkenrath, P. Moerk-Moerkenstein, U. Jung, and F.-J. Weckermann Brussels Dec. 1967 132 p refs In ITALIAN; ENGLISH summary

(EUR-3658.d) CFSTI: HC $3.00/MF $0.65

The performance of nuclear reactors is significantly influenced by the critical heat flux density. In the pressure range of more than 170 bar, reactors may be operated near or even beyond the critical heat flux density without danger for the fuel element. It is therefore important to investigate the critical heat transfer regions and to know the maximum wall temperatures. Forced convection heat transfer conditions at pressures between 140 and 250 bar were measured at different heat flux and mass flow densities. The report presents the results obtained in vertically arranged test sections (circular tubes of 10 and 20 mm i.d.) with special regard to the wall temperature under the indicated test conditions. Author

N68-16711# Aeronautical Research Inst. of Sweden, Stockholm.

HEAT TRANSFER IN A TURBULENT BOUNDARY LAYER WITH A PRESSURE GRADIENT NORMAL TO THE FLOW

H. Thomann Jul. 1967 21 p refs

(FFA-113)

The effect of a pressure gradient along and normal to the flow direction is investigated experimentally at M=2.5. On a wall with a streamwise curvature the pressure gradient normal to the wall influences the turbulent exchange and thus heat transfer. For the arrangement investigated the boundary layer thickness is about 2% of the radius of curvature of the wall. On a concave wall with uniform pressure the heat transfer is increased by about 20% and on a convex wall it is decreased by the same amount. If the pressure gradient has a component normal to the flow but in the plane of the wall, it induces a three-dimensional boundary layer and can have a marked influence on the heat transfer, increasing it by up to 50%. For the present investigation the influence of the pressure gradient in the flow direction is well described by existing theories. Author

N68-16740# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

THERMAL CONDUCTIVITY OF URANIUM OXYCARBIDES

J. Lambert Bates 24 Oct. 1967 25 p refs Presented at the 7th Ann. Conf. on Thermal Conductivity, Washington, D. C., 13–16 Nov. 1967

(Contract AT(45-1)-1830)

(BNWL-SA-1494; CONF-671114-1) CFSTI: HC $3.00/MF $0.65

The thermal diffusivity of uranium oxycarbide was measured at 100 to 1400°C as a function of oxygen concentration at 2 to 17 at. % of the anions. The thermal diffusivity (α) of the oxycarbides decreased and the shape of the α-versus-T curve changed as the

oxygen content increased. Oxycarbides with the lowest oxygen content showed a decrease in α as the temperature increased, whereas the oxycarbides with the highest oxygen content exhibited a slight increase in α with an increase in temperature. The thermal diffusivities of all specimens, approach a common value near 0.05 cm^2/sec at the higher temperatures. The calculated thermal conductivities near 1500°C of the uranium oxycarbides are approximately 0.18 watts/cm-°C, very near the reported values for nearly stoichiometric and slightly hypostoichiometric UC. Author (NSA)

N68-16767# France. Ministere de l'Air, Paris.
COMBUSTION OF SOLID PROPERGOLS [LA COMBUSTION DES PROPERGOLS SOLIDES]
Alexandre Billard 1967 95 p refs In FRENCH
(Rept.-437)

A rational relation is established between the speed of combustion and the parameters which govern the phenomena. Basic physics principles are reviewed in terms of particle energy, the kinetic theory of gases, chemical kinetics, the electromagnetic field, radiation, and molecular dissociation. The characteristics of explosive substances are defined, and the classical theory of combustion is stated and applied to propellant combustion. The processes which contribute to combustion and to detonation are discussed, and three modes of dissociation are identified: the actions caused by contact, kinetic energy, and radiation energy. Consideration is also given to combustion in a bomb, in artillery, and in the propulsion chamber of an engine. The observable phenomena are assessed to determine the values of the different parameters, and to verify the experimental results with theory. Transl. by M.G.J.

N68-16777# Argonne National Lab., Ill.
THERMOPHYSICAL PROPERTIES OF SODIUM
G. H. Golden and J. V. Tokar Aug. 1967 102 p refs
(Contract W-31-109-ENG-38)
(ANL-7323) CFSTI: HC $3.00/MF $0.65

The literature about sodium properties through 1966 was reviewed as a basis for recommending current best values for such properties. Consideration was given to the liquid density, vapor pressure, thermodynamic and P–V–T properties, transport properties, electrical resistivity, and surface tension, as well as the thermal expansion coefficient, compressibility, and sonic velocity of the liquid. A Fortran subroutine was written to compute the enthalpy and entropy of sodium in a given state, and also the composition, mean molecular weight, specific volume, and compressibility factor of the corresponding vapor. Tabular results for the saturated liquid and vapor are presented in an appendix for the range 500° to 2500°F, in 10° increments. Also given are derived H–S and T–S diagrams. The transport properties are the viscosity and thermal conductivity of the saturated liquid and vapor; these are also presented in tabular form for the range 210° to 2500°F, in 10° increments. Author (NSA)

N68-16780# Royal Aircraft Establishment, Farnborough (England).
GASEOUS EXPLOSIONS IN DUCTS [GASEXPLOSIONEN IN ROHRSTRECKEN]
W. Bartknecht Jul. 1967 41 p refs Transl. into ENGLISH from Bergfreiheit, (USSR), v. 31, no. 5, 1966 p 101–117
(RAE-LIB-TRANS-1240)

Experiments with apparatus which simulates industrial plant and the measures which may be taken to provide protection against the effect of explosions are investigated. The factors which influence the development and propagation of explosions in closed vessels and ducts are discussed. Explosion suppression with rapidly dispersed extinguishants and flame traps are used to prevent flame propagation but in conditions where explosion and detonation cannot be avoided with certainty the application of explosion doors and bursting discs is essential. These devices were tested and their effectiveness in explosion relief is reported. Author

N68-16813*# National Aeronautics and Space Administration, Washington, D. C.
INVESTIGATION OF A RADIATOR SYSTEM WITH CONIC HEAT TRANSFERRING SPIKES [ISSLEDOVANIYE IZLUCHATEL'NOY SISTEMY S KONICHESKIMI TEPLOOTVODYASHCHIMI SHIPAMI]
Yu. G. Zhulev and Yu. F. Potapov Jan. 1968 9 p Transl. into ENGLISH from Russian Presented at the 18th Congr. of the Intern. Astronautical Federation, Belgrade, 25–30 Sep. 1967
(NASA-TT-F-11499) CFSTI: HC $3.00/MF $0.65 CSCL 13A

An analysis is presented of the problem of the design and optimization of a radiating system consisting of radially placed conical spikes on an isothermal, cooled sphere. The case is analyzed when the radius of the sphere is determined from the condition that the bases of the most closely placed spikes meet at the surface of the sphere and the spikes are so placed that the points of intersection of their axes with the surface of the sphere are the peaks of a right polyhedron inscribed within the sphere. Analysis of the relations produced indicates that the solution of the problem can be reduced to the solution of a system of two equations with two unknown functions for the temperature at a given distance from the base of a spike and the effective radiation density at the given distance from the base of the spike. The method of calculation can be extended to include systems with various groups of spikes under various conditions of radiation interaction. Author

N68-16827*# National Aeronautics and Space Administration, Washington, D. C.
OPTIMUM SYSTEMS FOR DISSIPATING HEAT BY RADIATION [OPTIMAL'NIYE SYSTEMY OTVODA TEPLA IZLUCHENIYEM]
G. L. Grodzovskiy and Yu. G. Zhulev Dec. 1967 9 p refs Transl. into ENGLISH from RUSSIAN Presented at the 18th Congr. of the Intern. Astronautical Federation, Belgrade, 25–30 Sep. 1967
(NASA-TT-F-11433) CFSTI: HC $3.00/MF $0.65 CSCL 13G

This discussion of radiator systems for dissipating heat energy includes consideration of optimum heat-dissipating elements with minimum mass, energy-dissipating systems using a flat tubed radiator with fins, and a tubed radiator with a satellite arrangement of fins. Annular heat-dissipating fins and systems for using a belt to carry heat away are also described, along with generalized characteristics of heat-dissipating radiator systems. Author

N68-16855*# National Aeronautics and Space Administration, Washington, D. C.
SOME GENERAL INEQUALITIES OF CHEMICAL THERMODYNAMICS FOR THE CASE OF PARTIAL EQUILIBRIUM
A. S. Pleshanov *In its* Studies in Phys. Gas Dyn. Feb. 1968 p 146–147 refs (See N68-16839 07-12)

Described is an algebraic method for describing general inequalities of chemical thermodynamics of a reacting gas system during unfreezing, i.e., transition from the complete absence of equilibrium through a state of partial equilibrium to complete equilibrium. It is hypothesized that: if r independent reactions transfer to a state of complete equilibrium in the reacting system, 2^r states of partial equilibrium are possible with respect to small

disturbances; one of these states is completely nonequilibrium; r−1 reactions in r states are completely nonequilibrium and one arbitrary reaction is completely equilibrium; r−2 reactions in r(r−1)/2 states are completely nonequilibrium and 2 arbitrary reactions are completely equilibrium, etc. Presented is a proof that demonstrates that the quantities (derived from equations used to determine the character of change as the reacting system unfreezes) vary monotonically in proportion to the monotonic unfreezing of the system. It is surmised that differences between other paired quantities vary monotonically only when the number of particles is constant during each equilibrium reaction. S.C.W.

N68-16883*# National Aeronautics and Space Administration, Washington, D. C.
NONSTATIONARY HEAT EXCHANGE IN THE REFLECTION OF A SHOCK WAVE
Yu. A. Polyakov *In its* Studies in Phys. Gas Dyn. Feb. 1968 p 213–223 refs (See N68-16839 07-12)

The applicability of calorimetric transducers in measuring nonstationary heat exchange in the reflection of a shock wave from a solid wall is discussed. Shock tube experiments which demonstrate advantages of the calorimetric method over the film transducer are described. S.C.W.

N68-16884*# National Aeronautics and Space Administration, Washington, D. C.
HEAT LOSSES ASSOCIATED WITH THE REFLECTION OF A SHOCK WAVE FROM THE END OF A TUBE
O. A. Predvoditeleva *In its* Studies in Phys. Gas Dyn. Feb. 1968 p 224–226 refs (See N68-16839 07-12)

Heat losses associated with the reflection of a shock wave from the end of a tube were studied in an attempt to validate the assumption that the heat flow from a reflected wave of heated gas to the end of a shock tube is equal to the heat flow to the lateral wall. Heat flow was determined by the surface temperature of the shock tube as measured by platinum resistance thermometers. The velocity of the shock waves was determined by photographs of the Topler pattern of flow. Assuming that the heat flow to the end of the shock tube was constant and equal to the maximum value of the flow q, it is shown that the amount of heat absorbed by the end in the time t=7 can be calculated with the formula $Q_{end}^{exp} = qSt$, where S is the area of the end (16 cm^2) and q is the heat flow. Heat quantities estimated according to this method are tabulated. On the basis of calculated values, it is concluded that energy losses caused by the heat conductivity of the metallic end during shock wave reflection amount to approximately 2 to 10% of the total quantity of losses observed during reflection of the shock wave. S.C.W.

N68-16885*# National Aeronautics and Space Administration, Washington, D. C.
FORMATION OF A GAS FLOW BEFORE A FLAME FRONT
G. D. Salamandra *In its* Studies in Phys. Gas Dyn. Feb. 1968 p 227–233 refs (See N68-16839 07-12)

An analysis of the state of a gas before a flame front at various moments of time, which was conducted for various conditions of the combustion process, indicated that: (1) while the flame front propagates with acceleration, the gas velocity, density, and pressure achieve a maximum value directly before the flame front and decrease as the distance from the flame front increases. (2) A decrease in the velocity of flame propagation is accompanied by an increase in the distance from the region of maximum gas velocities, pressures, and densities to the flame front. (3) The transition from slow buring to detonation takes place in a medium that has been prepared by the compression waves generated by the flame front in the predetonation state. (4) The state of a gas before a flame front can be calculated with sufficient accuracy by the characteristic curve method, and it should be considered in the calculation that the velocity of the gas before the flame front, which overlaps the entire tube section, amounts to ≈0.8 of the flame velocity. S.C.W.

N68-16885# California Univ., Berkeley. Lawrence Radiation Lab.
IGNITION OF FUEL DROPLETS IN HOT STAGNANT GASES
Gordon Alfred Long (M.S. Thesis) Sep. 1967 76 p refs
(Contract W-7405-ENG-48)
(UCRL-17811) CFSTI: HC$3.00/MF$0.65

A technique was developed for study of self-ignition of fuel droplets in air that enables measurement of ignition delay and observation of the formation of the initial flamefront under near-stagnant conditions at elevated temperatures and atmospheric pressure. This method involves the very rapid insertion of a hollow filament filled with the fuel to be studied into a furnace that allows precise control of the experimental environment temperature up to 1500°C. Immediately following insertion, a droplet is formed at the filament tip. The ensuing ignition is recorded by a high speed (approximately 1000 frames per second) motion picture camera. This technique was applied to the study of ignition of n-heptane droplets in the temperature range of 500 to 860°C. Ignition delay times from 850 msec to 22 msec were reported, which appear to be generally consistent with values reported by other investigators but somewhat longer than those measured under conditions of forced convection. Initial flamefronts were observed to form in an approximately spherical configuration at a distance from the surface of the droplet and to move outward slightly following formation. Author (NSA)

N68-16886# California Univ., Berkeley. Lawrence Radiation Lab.
COMBUSTION OF HEPTANE DROPLETS IN A HOT GAS FLOW
Joel Lawrence Bert (M.S. Thesis) Oct. 1967 74 p refs
(Contract W-7405-ENG-48)
(UCRL-17438) CFSTI: HC$3.00/MF$0.65

Burning rates of individual n-heptane droplets were measured under forced convective conditions and environmental temperatures of 550 to 700°C. The droplets were supported in hot air stream rising at approximately their terminal velocity and their burning histories were recorded by high-speed motion-picture photography. From analysis of the photographs data on droplet size, convective velocities and burning rates were obtained. The effects of gas temperature, drop size, and convection on droplet burning rate coefficients were studied. In the size range studied, 100 to 500-μ droplet diameter appeared to have no effect on burning rate coefficients. The coefficients were also not noticeably influenced by convection for relative velocities up to 90 cm/sec. These results are in accord with predictions of simplified combustion models. However, the observed rate of increase of burning rate coefficient with increasing temperature between 550 and 700°C was much greater than present combustion theory would predict, but is consistent with the few results of other investigators available for elevated environmental temperatures. Author (NSA)

N68-16898*# Franklin Inst., Philadelphia, Pa. Research Labs.
REVIEW OF LITERATURE ON THERMAL CONTACT CONDUCTANCE IN A VACUUM Final Report

S. P. Carfagno Apr. 1967 115 p refs
(Contract NAS8-20373)
(NASA-CR-61556; F-C1882) CFSTI: HC $3.00/MF $0.65 CSCL 20M

The literature on thermal contact conductance in a vacuum is reviewed. Following a discussion of the fundamentals of heat transfer across an interface, the results of several theories which ignore surface waviness and one which attempts to account for it are presented. Attempts at data correlations are also described. Surface structure and the deformation of surfaces under load, as they affect the actual contact area and thermal conductance at an interface, are discussed in some detail. The use of interface fillers and the results of studies of heat transfer across bolted and riveted joints are also discussed. References are given to the dominant sources of data in the literature. Author

N68-16904*# Avco Corp., Tulsa, Okla. Electronics Div.
STABILITY OF THERMAL CONTROL COATINGS EXPOSED TO COMBINED SPACE ENVIRONMENTS Draft Report, Jun. 1966–Aug. 1967
William R. Holland Dec. 1967 111 p
(Contract NAS2-3646)
(NASA-CR-73160) CFSTI: HC $3.00/MF $0.65 CSCL 20M

An *in situ* reflectometer system was designed, fabricated and installed in an existing space simulation facility. After installation of the *in situ* system, qualification tests were conducted on the system. Tests were conducted on twelve materials including combined environment of vacuum, protons and ultraviolet, protons and vacuum only, ultraviolet and vacuum only and vacuum only. The ZnO/K_2SiO_3 was found to be more susceptible to protons and less to ultraviolet radiation and the La_2O_3/K_2SiO_3 more susceptible to ultraviolet radiation with very little damage by protons. Of the powdered samples tested only the TiO_2 showed measurable damage with protons only irradiation. Author

N68-16917*# United Technology Center, Sunnyvale, Calif. Research and Advanced Technology Dept.
STUDIES ON IGNITION AND FLAME PROPAGATION OF SOLID PROPELLANTS Final Report, 22 Jun. 1966–22 Jun. 1967
J. D. Kilgroe 13 Nov. 1967 131 p refs Prepared for JPL
(Contract NAS7-479)
(NASA-CR-92677; UTC-2229-FR) CFSTI: HC $3.00/MF $0.65 CSCL 21B

The objectives of this program are to analyze and correlate experimental data obtained for pyrogen igniters. These correlations were conducted to provide an analytical characterization of the igniter heat input to the solid propellant surface in order to provide information for igniter design and definitions of ignition transients. Author

N68-17030# Aeronautical Research Inst. of Sweden, Stockholm.
HEAT TRANSFER MEASUREMENTS AT M=7.17 FIRST STEP OF A COMPARISON BETWEEN TUNNEL TEST AND FREE FLIGHT
H. Thomann Feb. 1967 15 p refs
(PB-176096) CFSTI: HC $3.00/MF $0.65

A paraboloid free flight model was designed, built and instrumented at the Royal Aircraft Establishment (RAE) in Farnborough. Prior to the flight, this model was tested in the hypersonic tunnel Hyp 500 at the Aeronautical Research Institute of Sweden (FFA). The model was designed to have uniform wall temperature during the test. As the same model is used in both tests and as the Mach number, the Reynolds number and the ratio wall temperature to free stream temperature are very nearly the same in both cases, the tunnel tests are an almost perfect simulation of the flight test. The tunnel tests (heat transfer and pressure distribution) are presented and compared with theory. Author

N68-17035# Aerochem Research Labs., Inc., Princeton, N. J.
FLAME IONIZATION AND COMBUSTION INHIBITION
William J. Miller Jan. 1967 26 p refs
(Contract CST-102)
(TP-151; TR-1)

The inhibition of spherically symmetrical low-pressure CH_4 or C_2H_2/O_2 diffusion flames by a variety of additives has been studied. The relative efficiencies of the compounds studied have been found to be very nearly the same as in 1-atm flames. A detailed examination of the effects of CCl_4, $Fe(CO)_5$, and CrO_2Cl_2 upon ion content and emission spectra has been made and the results interpreted in terms of previously postulated correlations between the ability of a given compound to reduce electron concentrations and its effectiveness as a flame inhibitor. No such correlation was found to exist and it has been concluded that for these flames no causal relationship exists between the two phenomena. The relatively large inhibition efficiencies of $Fe(CO)_5$ and CrO_2Cl_2 are attributed to *in situ* ultrafine particle formation downstream of the flame front and their subsequent diffusion into the reaction zone. The formation of these particles is indicated by ion profiles of nucleating species; the presence of the particles in the reaction zones of inhibited flames is further evidenced by the emission of continuum radiation. The dominance of diffusional over convective mass transport is the characteristic of the system which accounts for its susceptibility to inhibition by these compounds. Author

N68-17044*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ACCURATE SURFACE TEMPERATURE MEASUREMENTS AT LIQUID HELIUM CONDITIONS IN SPACE ENVIRONMENT FACILITIES
John F. Cassidy and Walter M. Krawczonek Washington 1968 21 p refs To be presented at 2d Flight Test, Simulation, and Support Conf. sponsored by AIAA, Los Angeles, 25–27 Mar. 1968
(NASA-TM-X-52386) CFSTI: HC $3.00/MF $0.65 CSCL 20M

An accurate temperature sensor, consisting of a germanium resistance thermometer, a lead-wire heat sink, and a high thermal conducting epoxy fastening method is available for measuring wall temperatures of large liquid helium cooled space environment facilities. Indicated wall temperature measurements have errors less than +0.03°K at liquid helium conditions. Cycling tests from 473°K to 4.2°K demonstrated stability of germanium resistors in vacuum facilities using a mild bake-out. A high thermal conductivity epoxy minimizes the vacuum thermal contact resistance between the sensor envelope and the wall. The lead-wire heat source into the sensor was minimized by using a thin fiberglass-copper heat sink in the voltage and current measuring circuit. Error determinations were made by referencing the sensor temperature to the liquid helium temperature in the Lewis Research Center's 6' × 10' Space Environment Facility. The helium vapor pressure data was used to determine the liquid helium temperature in the space simulator. Author

N68-17078# Iowa State Univ. of Science and Technology, Ames.
THE THERMAL DIFFUSIVITY OF GOLD
H. R. Shanks, M. M. Burns, and G. C. Danielson 27 Oct. 1967 9 p refs Presented at 7th Conf. on Thermal Conductivity, Gaithersburg, Md., 13–16 Nov. 1967
(IS-1713; CONF-671110-2) CFSTI: HC $3.00/MF $0.65

The thermal diffusivities of four gold samples were measured from 325 to 1225°K. The sample purities varied from about 95 to 99.999% and the resistivity ratios from 3 to 600. The thermal diffusivity of gold was found to be sensitive to the impurity concentration. The thermal diffusivity data were combined with published specific heat data to obtain thermal conductivity values. Electrical resistivity and Seebeck coefficient measurements were also made on the samples. Author (NSA)

N68-17106# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

HEAT TRANSFER IN A TRANSVERSE HOMOGENEOUS MAGNETIC FIELD [TEPLOOBMEN V POPERECHNOM ODNORODNOM MAGNITNOM POLE]

Yu. A. Mikhaylov and R. Ya. Ozols 24 Jul. 1967 16 p refs Transl. into ENGLISH from Izv. Akad. Nauk Latv. SSR, Ser. Fiz. i Tekhn. Nauk (Riga), no. 2, 1963 p 19–26

(Contract AF 33(657)-16408)

(FTD-HT-67-476; AD-663340)

The study considers the transfer of heat in the steady laminar motion of an incompressible electrically conductive liquid to the isothermal walls of a channel formed by parallel plates. Demonstration is made of the influence of a transverse homogeneous magnetic field on heat transfer for the case of a constant medium flow rate and a constant pressure difference. It is ascertained that there is a substantial relationship between the temperature of the liquid flow and the heat-transfer Nusselt number with respect to the magnitude of the external magnetic field and the electrical conductivity of the channel walls. TAB

N68-17141# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.

SPECIFIC HEAT MEASUREMENTS ON METALS UP TO THEIR MELTING POINT [MESURE DE LA CHALEUR SPECIFIQUE DES METAUX JUSQU'A LEUR TEMPERATURE DE FUSION]

Christian Affortit Jul. 1967 63 p refs In FRENCH

(CEA-R-3287)

An apparatus was built to measure the specific heat of metal up to the melting point. The method is the pulse-heating method, where the specimen is heated very rapidly (1/10S) from room temperature to the melting point by a very intense dc current (1000 A). The simultaneous measurements of intensity, voltage and temperature in the specimen allows a calculation of the specific heat. Good results were obtained for niobium, tungsten, tantalum and uranium. Accuracy is from 3 to 5% and allows the measurement of the heat of formation of vacancies near the melting temperature. Author (NSA)

N68-17142# National Engineering Lab., Glasgow (Scotland).

THERMAL DESIGN OF CONDENSERS

Jan. 1967 99 p refs Presented at NEL Meeting, Glasgow, 5 Jan. 1966

(NEL-270; CONF-660120) CFSTI: HC$3.00/MF$0.65

A meeting held to allow an exchange of views and experience on thermal design between people interested in the research, design, manufacturing, and user aspects of condensers is reported. Discussions were included on prediction of required surface area and pressure gradients in condenser tube banks, regenerative and by-pass lanes, and air cooler and sizing of air ejector systems. Author (NSA)

N68-17158# Naval Weapons Evaluation Facility, Albuquerque, N. Mex.

ANALYSIS OF HEAT TRANSFER IN A TWO-LAYER CIRCULAR CYLINDER: CONSTANT FLUX ON OUTER SURFACE AND ZERO FLUX ON INNER SURFACE

M. Elena Franklin (M.S. Thesis—New Mexico Univ.) 30 Oct. 1967 73 p refs

(NWEF-1015; AD-663282)

The one-dimensional time-dependent equation of heat conduction is solved analytically for an infinite two-layer circular cylinder which may have either a hollow or a solid core. The layers are in perfect thermal contact with a constant heat flux applied uniformly on the outside of the cylinder and zero heat flux on the inside. The solution for the temperature within each layer of the cylinder is in the form of Bessel functions or infinite series. It is found from the heat-conduction equation by using the method of separation of variables, by homogenizing the boundary conditions, by applying the boundary conditions, and by determining eigenvalues and eigenfuctions. Author (TAB)

N68-17216# California Univ., Livermore. Lawrence Radiation Lab.

OPTIMAL AND ANHARMONIC THERMAL PROPERTIES OF A DIATOMIC MOLECULAR SOLID

George Jelinek 11 Oct. 1967 6 p refs Presented at the 2d Mater. Res. Symp., Gaithersburg, Md., 16–19 Oct. 1967

(Contract W-7495-ENG-48)

(UCRL-70723; CONF-671028-2) CFSTI: HC$3.00/MF$0.65

A primitive rhombohedral equilibrium structure with large vibrational excursions from the equilibrium configurations is assumed for oxygen, nitrogen, and fluorine at low temperatures. The assumed structure involves cubic close packing of cylinders, and the effects of the harmonic, cubic, and quartic potential are considered. Thermodynamic properties calculated on this basis are in good agreement with experimental results for oxygen, nitrogen, and fluorine. Calculated results are less satisfactory for CO, and poor for chlorine, bromine, and iodine. Calculations concerning infrared spectra also show reasonable agreement with experimental results. NSA

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N68-16231# Royal Netherlands Aircraft Factories Fokker, Amsterdam.

THE ECONOMIC NECESSITY OF A EUROPEAN AIRCRAFT INDUSTRY

F. J. L. Diepen 14 Sep. 1967 22 p refs Presented at the Aviation and Tech. in the European Econ. Symp., London, 13–14 Sep. 1967 /*ts* Lecture No. 1

A comparison is made between the aerospace industry in the United States and that of Western Europe in terms of research and development expenditures, sales, gross national products, population and work force statistics, airline ton-miles flown, airline revenues, and aircraft inventories. A thesis is developed which argues that the only way to reverse the widening gap depicted in the comparisons is to provide for a sense of unity on

the part of the various European governments and aerospace industries. The point is made that local, nationalistic barriers must be eliminated and the combined industrial and population potential fully realized if Europe is to possess an aerospace industry of economic and political significance. E.J.S.

N68-16246# Oak Ridge National Lab., Tenn.
RESPONSE OF INFLUENTIALS TO NEGATIVE CONTINGENCIES
Sue Berryman Bobrow Nov. 1967 51 p refs
(Contract W-7405-ENG-26; ARPA Order 907)
(ORNL-TM-1817) CFSTI: HC $3.00/MF $0.65

This report is divided into five sections: (1) Introduction, where we try to give the reader an intuitive understanding of our intellectual questions; (2) Independent and Dependent Variables, where we talk about the parameters of the phenomenon we want to explain; (3) Hypotheses, where we state some of the ideas we now have about why different individuals and groups start at the same point and come out at sometimes the same, sometimes different, points; (4) Intervening Variables, where we talk about the variables which are involved in the hypotheses and have to be differentiated so we can design measures of them and thus test the relevance and power of our hypotheses, and (5) Theory of Action and Person and Group Differences, where essentially we just refer to, not discuss, work on an analytic system for talking about what persons and groups do and what kinds of persons and groups they are. Author (NSA)

N68-16336*# San Diego State Coll., Calif.
THE NASA SOURCE EVALUATION BOARD PROCESS: A DESCRIPTIVE ANALYSIS
Richard H. Nolan (M.S. Thesis) Houston, Tex. NASA. Manned Spacecraft Center Dec. 1967 70 p refs Sponsored by NASA
(NASA-CR-65934; MSC-BM-MR-67-2) CFSTI: HC $3.00/MF $0.65 CSCL 05A

Numerous methodologies were employed in gathering the data necessary to reach conclusions about the Source Evaluation Board (SEB) process, including personal interviews held with officials at NASA headquarters. The printed data which were available and reasonably related to the SEB process were also consulted, and this material varied from books and articles to on-site reports of SEB operations. The author's observations resulted from an examination of the SEB review process as applied to two contract competitions at MSC. The data from this study indicate that the NASA/SEB process operates upon numerous and varied foundations. A number of benefits which accrue from SEB activities are not directly related to the goal of selecting the most competent contractor. For example, the SEB process is an effective measuring device used by the NASA Administrator to determine how well contractors are developing their capabilities and to gauge the quality of the thinking of top NASA officials. According to evidence obtained, the operational aspects of the process are basically sound. Author

N68-16376# Office of Aerospace Research, Washington, D. C.
PROCEEDINGS OF THE OAR RESEARCH APPLICATIONS CONFERENCE, 14 MARCH 1967
Mar. 1967 126 p refs Presented at OAR Res. Appl. Conf., Washington, D. C., 14 Mar. 1967
(OAR-607-2, V. 2; AD-662887) CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. POSITIVE ION-SENSING SYSTEM FOR THE MEASUREMENT OF SPACECRAFT ATTITUDE R. C. Sagalyn and M. Smiddy (Air Force Cambridge Res. Labs.) p 1–18 refs (See N68-16377 07-14)

2. INVESTIGATION OF OPTIMUM LIFTING BODIES W. L. Hankey (Aerospace Res. Labs.) p 21–37 refs (See N68-16378 07-01)

3. GASDYNAMICS OF EXPLOSIONS AND ITS RELEVANCE TO PROPULSION A. K. Oppenheim (Calif. Univ) p 39–56 refs (See N68-16379 07-33)

4. THE OVI-PROMOTER OF TIMELY SPACED RESEARCH C. A. Northcott, Jr. p 59–67 (See N68-16380 07-30)

5. COMPUTER-AIDED CIRCUIT DESIGN D. A. Calahan (Mich. Univ.) p 69–79 refs (See N68-16381 07-09)

6. A FAMILY OF NOVEL ANTENNAS: THE "BACKFIRE" ANTENNA H. W. Ehrenspeck (Air Force Cambridge Res. Labs.) p 81–104 refs (See N68-16382 07-07)

7. THE GENERATION OF SCIENCE-BASED TECHNOLOGY IN THE FIELD OF CRYSTALLIZATION W. A. Tiller (Stanford Univ.) p 107–155 refs (See N68-16383 07-26)

8. SUPERSONIC COMBUSTION SIMULATION R. G. Dunn (Aerospace Res. Labs.) p 157–182 refs (See N68-16384 07-11)

9. PREDICTION OF THE DYNAMIC STABILITY OF NOSE CONES B. P. Quinn (Aerospace Res. Labs.) p 189–208 refs (See N68-16385 07-01)

10. ORGANIC PHOTOVOLTAIC DEVICES A. Golubovic (Air Force Cambridge Res. Lab.) p 211–225 refs (See N68-16386 07-26)

11. TIME-OPTIMAL ATTITUDE CONTROL OF A SPINNING VEHICLE D. H. de Does (Air Force Academy) p 227–235 refs (See N68-16387 07-21)

N68-16472# Advisory Group for Aeronautical Research and Development, Paris (France).
INFORMATION BULLETIN, NUMBER 67/3
Nov. 1967 30 p refs Presented at 3d Ann. Meeting of AGARD, Turin, 7–8 Sep. 1967
CFSTI: HC $3.00/MF $0.65

Highlights of the AGARD annual meeting are reported, and the text of several speeches made at the conference are presented. The importance of better technological cooperation between the North American countries and Europe is stressed, and the limitations on the ability of NATO and its agencies to resolve the problem of the technological gap are assessed. The achievements during 15 years of AGARD activity are reviewed. The relations of AGARD with the Military Committee are discussed in terms of the importance of research and development in military technologies necessary to preserve the military power of the Alliance. Also discussed are the problems of international cooperation involved in the design and construction of aircraft. M.G.J.

N68-16699# European Space Vehicle Launcher Development Organization, Paris (France).
REPORT TO THE COUNCIL OF EUROPE FOR 1966
1966 42 p
CFSTI: HC $3.00/MF $0.65

Ministerial conferences held in 1966 were concerned with the ELDO initial and supplementary programs and plans for coordinating European space policy. The ELDO supplementary program comprises a perigee–apogee system (PAS) which, added to Europa I, may inject a payload of 150 kg into a geostationary orbit; an operational base in French Guyana and an inertial guidance system for Europa I. ESRO

N68-16828# Lockheed Missiles and Space Co., Sunnyvale, Calif. Technical Information Center.
BIBLIOGRAPHY OF LMSC BIBLIOGRAPHIES Citation Bibliography

George R. Evans, ed. Jan. 1968 119 p refs 2d Ed. Supersedes LMSC-5-10-64-2; SB-64-7, Jan. 1964; See N64-20533
(LMSC-5-10-67-16; LMSC-5-10-64-2; CB-68-1; SB-64-7)

Cumulative bibliographical listings are presented under the headings: literature searches, special, special research, and citation bibliographies. A subject index is included. The bibliographies were primarily compiled from company technical literature search efforts from 1958 to time of publication. E.C.

N68-16873# Palermo Univ. (Italy). Inst. of Aeronautics.
INVESTIGATION OF THE POSSIBILITY OF INSTALLING NEW AERONAUTICAL INDUSTRIES IN ITALY [INDAGINE SULLA POSSIBILITA DI INSTALLARE NUOVE INDUSTRIE AERONAUTICHE IN ITALIA]
Giovanni Lanzara 20 Nov. 1967 45 p refs In ITALIAN *Its* Nota 2
CFSTI: HC $3.00/MF $0.65

The need to develop the civil air transport industry and technology in Italy is discussed, and the possible markets are considered for a variety of aircraft types. Mention is made of single and multi-motored tourist aircraft and executive planes, short-range planes capable of carrying 40 to 50 passengers, medium-range aircraft, and aerobuses. Subsonic aircraft with large capacity and long distance possibilities are discussed; as are cargo planes, supersonic planes, and prospects of ground effect vehicles. Ultrahigh speed ground transportation is mentioned; and the capacity of the aeronautical industry in non-communist nations is considered. In addition to the need for aeronautical industry for Italy, the prospects for Sicily are discussed. Transl. by M.W.R.

N68-16889*# Northwestern Technological Inst., Evanston, Ill. Dept. of Industrial Engineering and Management Sciences.
PROGRAM OF RESEARCH ON THE MANAGEMENT OF RESEARCH AND DEVELOPMENT Annual Report, 1966–1967
Albert H. Rubenstein Sep. 1967 29 p
(Grants NsG-495; NSF G-24442; PHS-LM-00098-01; Contract N00014-66-C-0020-A01)
(NASA-CR-93000) CFSTI: HC $3.00/MF $0.65 CSCL 05A

The basic characteristics of the research program are discussed in terms of the integrated approach taken toward the whole set of projects. Summary information is presented on the objectives and the progress achieved for such projects as idea flow in research and development; research and development control in decentralized organizations; organization strategies and research diffusion in developing countries; research and development responses to crises; sources of research and development achievements in electronics since 1945; the acquisition and development of new technical skills in research and development; integration and utilization of management science activities in organization; transition and interface problems between phases of research, development, and application; information-seeking behavior of researchers; project selection in research and development; key researchable problem areas in research and development management; environmental and management factors influencing the performance of research and development groups; and methodology of research on research. M.G.J.

N68-16893# Research Analysis Corp., McLean, Va.
LINEAR PROGRAMMING MODELS FOR CONSTRUCTION PLANNING USING THE ENGINEER FUNCTIONAL COMPONENTS SYSTEM
Jerome Bracken and Albert D. Tholen Aug. 1967 30 p refs
(Contract DA-44-188-ARO-1)
(RAC-TP-263; AD-663364)

The Engineer Functional Components System is used by the Army in planning construction of facilities and installations. This operational system employs numerous and extensive tape files containing bills of material for several hundred types of military installations comprised of thousands of items of material. The linear programming models discussed herein use this system in formulating linear constraints on construction capabilities due to resource limitations, and linear criterion functions in terms of the various facilities and/or installations to be constructed. The models provide a capability to rapidly consider alternative construction programs. Single-period and multiperiod models are given, including modifications of the basic models to make them applicable to a wider range of problems. Author (TAB)

N68-17087# National Academy of Sciences–National Research Council, Washington, D. C. Space Science Board.
COSPAR TENTH PLENARY MEETING AND EIGHTH INTERNATIONAL SPACE SCIENCE SYMPOSIUM Preliminary Report
29 Jul. 1967 157 p refs Presented at Imperial Coll., London, 17–29 Jul. 1967

The activities of the meeting are described, and reports to the meeting are presented. Summaries are given of the work of the following groups: tracking, telemetry, and dynamics; design and coordination of experiments; data and publication; international reference atmosphere; space biology; and experiments concerned with properties and dynamics of the troposphere and stratosphere. N.E.N.

N68-17114# Association Internationale des Constructeurs de Materiel Aerospatial, Paris (France).
EUROPEAN COLLABORATION IN AIRCRAFT CONSTRUCTION
14 Sep. 1967 35 p Presented at AICMA Symp., London, 13–14 Sep. 1967 *Its* Paper No. 3

Consideration is given to the effects of cooperation in the various spheres of technology, production, economic, and human relations, and certain factors which govern the success of such cooperation are assessed. Data sheets are presented on several current and planned experiments including the Franco–German Transall military transport aircraft; Franco–British cooperation on the supersonic transport Concorde with its Olympus engine, and on the Martel missile; the Atlantic naval patrol aircraft with its Tyne engines, in which the industries of France, Germany, The Netherlands, and Belgium combined to make the airframe, and were joined by the British industry for the engines, and by Canada and the United States for the equipment; the Franco–British Jaguar trainer strike aircraft venture, which Germany may join; and the Franco–British–German Airbus program. Overall, the results of the past 15 years indicate that cooperative experiments were generally successful from the technical and industrial viewpoints, but have sometimes attracted criticism from the economic viewpoint. M.G.J.

N68-17115# Association Internationale des Constructeurs de Materiel Aerospatial, Pairs (France).
HOW EUROPE HAS BENEFITED TECHNOLOGICALLY FROM THE AEROSPACE INDUSTRY
S. Balke 14 Sep. 1967 19 p Presented at AICMA Symp. on the Importance of Aviation to the Econ. and Technol. Future of Europe, London, 13–14 Sep. 1967 *Its* Paper No. 2

The problems of European national-economic frontiers are examined in the context of the technological gap, and the successes achieved by the United States and the Soviet Union are discussed to illustrate the advantages that can be achieved by persistent promotion of technology, research, and education. The effect of the aviation industry and space technology on the general status of a country or of an integrated Europe are assessed to demonstrate

the impact such factors have on other facets of the economy. It is considered particularly important that the broadest possible technological basis be provided for fulfilling the aerospace industry development requirements. The point is made that this basis can no longer be provided within national frontiers, and that technological cooperation is an essential prerequisite for the existence of a European aerospace industry. M.G.J.

N68-17161*# New York Univ., N. Y. Graduate School of Public Administration.

PLANNING FOR IMPACT: A CASE STUDY OF THE IMPACT OF THE SPACE PROGRAM ON HUNTSVILLE, ALABAMA

Robert A. Myers Feb. 1967 419 p refs

(Grant NGR-33-016-067)

(NASA-CR-93066) CFSTI: HC $3.00/MF $0.65 CSCL 05C

An investigation is presented of the impact of the space program on Huntsville, Alabama. It is shown that impact repercussions can be understood and that urban planning studies can provide information sufficient to form a sound base for impact planning. Steps are indicated to show how planning can maximize impact benefits while reducing impact costs. It is found that the utilization of urban planning techniques is a means toward understanding the effects of impact. The distillation of impact response information through the planning process yields a long range guide for city development, and determines a short range strategy for the solution of impact problems. Other areas given detailed consideration are economic changes, population changes, and government responses. C.T.C.

N68-17166# Association Internationale des Constructeurs de Materiel Aerospatial, Paris (France).

AVIATION AND TECHNOLOGY IN THE EUROPEAN ECONOMY

Sep. 1967 80 p Proc. of the AICMA Symp. held in London, 13–14 Sep. 1967

The importance of efficient cooperation in the European Aviation Industry was stressed as was the need to develop more rapidly the growth of a large European home market. Decisions were taken to set up two working parties with the following terms of reference: (1) To identify the obstacles to effective cooperation in the areas of finance, technology, management, law, and customs, and to make recommendations for their removal, (2) To consider the economic consequences and long term implications of dollar purchases of aviation equipment (including the effects on the material supply industry), (3) To continue to support energetically the important cooperative work already being done between the I.S.O. and the AICMA standardization committee. It was also decided to make AICMA's view clear to European governments with the objective of promoting close cooperation between government and industry in the interest of a continuing prosperous and independent European Aviation Industry, which is essential to the necessary development of technology in Europe. Author

N68-17177# Western Reserve Univ., Cleveland, Ohio. Comparative Systems Lab.

A COMPUTER ORIENTED SCHEME FOR CODING CHEMICALS IN THE FIELD OF BIOMEDICINE

Marilyn E. Bobka and J. B. Subramaniam Jul. 1967 25 p refs

(Grant PHS-FR-100118)

(CSL-TR-11; PB-175808) CFSTI: HC $3.00/MF $0.65

A new technique for the computer handling of biomedical data was developed. It is a chemical notation in which complicated chemical structures may be expressed concisely by a single line of letters and numbers. It is a straightforward way of coding chemical compounds for mechanical retrieval and so to a degree bypasses the present confusion and frustration existing in chemical nomenclature. Despite the limitations and faults in the coding scheme, a relatively high degree of inter- and intra-coder consistency was achieved. Author

N68-17178# International Business Machines Corp., Gaithersburg, Md. Federal Systems Div.

COMPUTER CLASSIFICATION OF DOCUMENTS Annual Progress Report

John H. Williams, Jr. Dec. 1967 43 p refs Presented at the FID/IFIP Conf., Rome, 15 Jun. 1967 Submitted for publication

(Contracts Nonr-4456(00); AF 30(602)-4161)

(AD-663178)

A word selection measure is employed to delete those terms that rarely occur and those that have a low conditional probability of occurring in a category. A set of sample documents known to belong to each category is used to estimate the mean frequency, the within category variance and the between category variance of the remaining terms. These statistics are then employed to compute discriminant functions which provide weighting coefficients for each term. A new document is classified by counting the frequencies of the selected terms occurring in it, and weighting the difference between this vector of observed frequencies and the mean vector of every category. The probability of membership in each category is computed and the document is assigned to the category having the highest probability. For applications in which assignment to one category is not desirable, the probabilities can be used to indicate multi-category assignment. A thesaurus capability allows the following types of words to be considered equivalent: inflected words, compound words, and semantically similar words with different orthographic spellings. Since the technique is based on statistical measures, it can classify documents written in any language provided a sample set of documents in that language is available. Author (TAB)

N68-17189*# Wayne State Univ., Detroit, Mich. Center for Application of Sciences and Technology.

A MODEL OF AND PROBLEMS ENCOUNTERED IN A METROPOLITAN POLICE DEPARTMENT

Feb. 1968 65 p refs

(Contract NSR-23-006-044)

(NASA-CR-93160) CFSTI: HC $3.00/MF $0.65 CSCL 05K

This paper presents a conceptual model of a metropolitan police department as a Command-Control Post which consists of four functions or systems: command, information, weapons, and support. The objectives are defined in broad behavioral terms, which are then more rigidly defined as a set of five objectives and submitted as being those generally applicable to all metropolitan police departments. Assumptions are presented which form the basis for the development of the departmental model and consequently the understanding of its operations and behavior. Two main points are brought out by these assumptions; the first being that the department is basically an information processing system, and the second being that the information the department processes is utilized in the formation of "ideal" and "real" images of both itself and of the environment. It is then pointed out that the department must utilize these images in order to accomplish its objectives and that its ability to do so is complicated by the fact that a large portion of these images are the result of individual perceptions. Author

N68-17190# Western Reserve Univ., Cleveland, Ohio. Comparative Systems Lab.

TEXTUAL CORRELATES OF RELEVANCE: PRELIMINARY INVESTIGATIONS

Carolyn G. Zull and George J. Baumanis Jun. 1967 48 p refs
(Grant PHS-FR-00118-03)
(CSL-TR-9; PB-175561) CFSTI: HC $3.00/MF $0.65

A study of relevance through comparison of texts judged by users is reported. The relevant set of documents for each information request was characterized by textual properties. The validity of procedures and interpretations is discussed. Consideration is given to possible mechanization of the process and its possible usefulness in development of iterative searching procedures, in building profiles of user needs, and in improving aspects of information retrieval such as question analysis, indexing, thesaurus building, and system evaluation. Author

N68-17193# Congress. Senate. Committee on Aeronautical and Space Sciences.
NOMINATION OF DR. THOMAS O. PAINE TO BE DEPUTY ADMINISTRATOR OF THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
Washington GPO 6 Feb. 1968 Hearing before Comm. on Aeron. and Space Sci., 90th Congr., 2d Sess.

The committee on Aeronautical and Space Sciences of the United States Senate presents the minutes of the confirmation hearing for the deputy administrator of the National Aeronautics and Space Administration. Included is a biography of Dr. Thomas O. Paine. G.G.

N68-17198*# United Aircraft Corporate Systems Center, Farmington, Conn.
APOLLO APPLICATIONS PROGRAM DATA ARCHIVES
Clifford W. Williams, George E. Schmidt, Jr. and David L. Sharp 15 Feb. 1968 207 p refs
(Contract NAS12-556)
(NASA-CR-86029; HSER-4994) CFSTI: HC $3.00/MF $0.65
CSCL 05B

The requirements for a system that will collect, store, retrieve, and distribute experiments-related data are identified and investigated. The system is oriented toward the user of the data, and it is shown that the archives will provide a public service function to pull together technical information from government agencies. The work performed consisted of the following tasks: (1) a field survey of potential users to determine what their requirements will be, (2) definition of performance specifications and development of a first level flow chart for an information storage and retrieval system to serve the needs of future inquiries, (3) a study of the alternative structures which the archives might assume and make recommendations regarding the amount of decentralization required, (4) an investigation of the feasibility of including the archives within, or joining them to, the National Space Science Data Center, and (5) assess the state of the art of ADP hardware particularly suited to the unique information processing and storage tasks associated with a data archive. C.T.C.

N68-17214# Adviesbureau der Genie, the Hague (Netherlands).
HIT CHANCES IN CASE OF NUCLEAR ATTACKS ON POINT AND AREA TARGETS [TREFKANS BU NUCLEAIRE AANVALLEN OP PUNTDOELEN EN OPPERVLAKTEDOELEN]
J. P. Melegers Sep. 1967 69 p
(TDCK-49652; NR-175)

Presented are practical guidelines for determining the impact probability and the degree of damage in nuclear attacks on point and area targets. Hit probabilities and damages are determined numerically and graphically based on circular and percentile Gaussian distributions. Topography and structural characteristics of the target areas are taken into account, and angular as well as elongated target areas are considered. Nomographs with sample calculations are included. Transl. by K.W.

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